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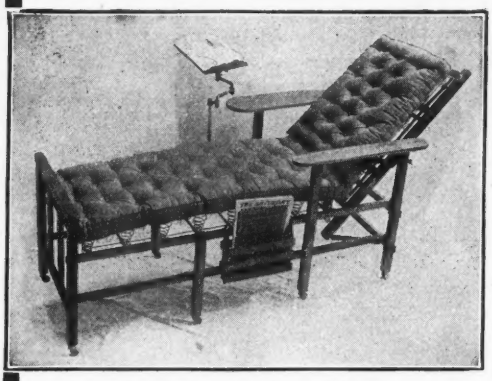

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A GLYCERIN "EXTRACT" OF TUBERCLE BACILLI AS AN ANTIGEN IN COMPLEMENT FIXATION

S. A. PETROFF

From the Trudeau Sanatorium, Trudeau, New York

Various antigens have been recommended during the last few years for use in complement fixation in tuberculosis, but the value of all (including my own (1)) depends in part, at least, on the personal equation. We have not as yet found one that may be called an ideal antigen; that is, one that can be easily prepared, without danger of infection to the user, and which can give uniform results with all investigators. Attempts have been made by some workers to compare the value of different antigens as to their antigenic properties, but the results obtained are most discouraging. The main error to my mind is in overlooking some factors which are important and which are responsible for this reaction, and in order to correlate any findings, the whole technic of the test must be standardized.

I should like to make the following suggestions about the technic we have adopted in our laboratory, which has worked very satisfactorily.

1. Antisheep system with two units of complement and two units of hemolytic amboceptor. Human system also may be used.

2. The patient's serum is inactivated at 56°C. for half an hour, and the primary antibody-antigen-complement system is incubated for one and one-half hours.

3. The "end reaction" reading is taken after the tests have been left in the ice box for twenty-four hours.

These are very important points and unless they are adopted we shall still continue to obtain conflicting results.

I shall not go into further details about the reaction itself, but propose briefly to describe the antigen which I have used since last October with fairly good results. There is no claim that this is a perfect antigen, but it is the one of those in use in our laboratory which has given me the best results.

At the beginning of my investigation of complement fixation I adhered to the theory that the unheated product of tubercle bacilli (containing some enzymes) was responsible for the reaction. But today my faith in such a theory is waning, for which the antigen that I am about to describe is responsible. This is a heated preparation which has been boiled for one hour at 105°C., which is the boiling point of 25 per cent glycerin in water.

The preparation of the antigen is as follows:

The tubercle bacilli are grown on 4 per cent glycerin-beef-broth for from four to six weeks until the whole surface is completely covered with a thick pellicle of tubercle bacilli. Such broth cultures are filtered through several thicknesses of filter paper, and washed with sterile distilled water until the filtrate is perfectly clear of broth. The tubercle masses thus obtained are spread over flat porcelain dishes and dried in a desiccator over sulphuric acid, which takes several days. These dry masses of tubercle bacilli are then pulverized in porcelain ball mills for several weeks.

One gram of pulverized tubercle bacilli is triturated in a mortar with 100 cc. of 25 per cent glycerin in water and boiled slowly for one hour in a flask having a return condenser. Vigorous boiling must be avoided. It is then set aside for several hours to allow the clumps to settle, the supernatant suspension is removed with sterile pipettes, put in sterile bottles of small size, and stored in a refrigerator. It will be found that 0.1 cc. of a 1 to 20 dilution represents one-sixth of the anticomplementary point.

The advantages of this antigen are as follows:

1. It is easy to prepare.
2. There is no danger of infection in handling it, as the prolonged boiling certainly kills the organisms.
3. It is less anticomplementary than antigen which has not been boiled and remains so for a long time unless it becomes contaminated.

The results obtained by us, when only one antigen is used, suggest that the above antigen gives by far the most reliable results.

REFERENCE

(1) Petroff, S. A.: Am. Rev. Tub., 1917, i, 33.

THE CLINICAL VALUE OF COMPLEMENT FIXATION IN PULMONARY TUBERCULOSIS BASED ON A STUDY OF 540 CASES

LAWRASON BROWN AND S. A. PETROFF

From the Trudeau Sanatorium, Trudeau, New York

SYNOPSIS

I. Introduction
II. Relation of complement fixation to:
1. Three stages of pulmonary tuberculosis
2. Duration of disease
3. Clinical data
4. Activity
5. Bronchial ulceration
6. Blood spitting
7. Exercise
8. Tuberculin tests:
a. Intradermic
b. Subcutaneous
9. Pleurisy with effusion
10. Artificial pneumothorax
11. Other diseases
12. Wassermann test
III. Changes in the complement fixation during sanatorium residence
IV. Comparative study of antigens
V. Conclusions

INTRODUCTION

The complement fixation tests were made by one of us (Petroff), who had in the vast majority of instances no previous knowledge whatsoever of the patient. At the weekly staff meeting at Trudeau each case is presented in all its details, and an attempt made to determine

1. Whether or not tuberculosis is present;

2. Whether if present it is merely a tuberculosis infection of small moment or clinical tuberculosis that is significant and requires observation and treatment;

3. Whether or not clinical activity is present.

To facilitate this, one of the clinical assistants reports in rather full detail all essential clinical facts relating to the case, which are copied

on a blackboard from the accompanying chart 1 so that all can have the data before them. The roentgenologist reports his findings from a study of stereoscopic plates, his interpretation of them (made independently) and further chances a guess as to the presence or absence of activity. With this data before the staff, the clinical assistant then determines whether or not tuberculosis, clinical tuberculosis, and activity are present. On a chart all this data with the assenting or dissenting opinions of the other members of the staff are noted and then the serologist reports his findings. We have endeavored to treat the patients during the past year as if no complement fixation test was done in an attempt to arrive at its true value.

The definition of "activity" will always arouse debate. We adopted hard and fast rules as follows:

When activity depended upon elevation of temperature alone, the temperature was always over 99° in a male and over 99.5° in a female. When the pulse rate rose frequently above 90 in a male and 96 in a female it was judged sufficient to indicate activity. However, a combination of lassitude, loss of weight, pleurisy, nightsweats, etc., was taken as significant of activity. On the other hand, cough, expectoration, tubercle bacilli in the sputum, dyspnoea or hoarseness were not taken as signs of activity. That this view of "activity" may not be widely accepted we recognize, but on the data based on these assumptions we have made our classifications.

It seems unnecessary to dwell upon the personal equations that invalidate all statistics based upon such data, but the recognition that such errors do exist will guard against all hard and fast conclusions.

In the 540 cases studied, a positive complement fixation test was found in 67 per cent, but if we consider only the 478 patients in whom a positive diagnosis of tuberculosis was made, it occurred in 72 per cent.

STUDY OF THE THREE STAGES OF PULMONARY TUBERCULOSIS

When we attempted to separate our cases into the usual three groups of incipient, moderately advanced, and far advanced, we found positive complement fixation occurring respectively in 51, 73 and 81 per cent. Of these incipient cases with positive complement

CHART 1

Name..... No.....

F. H..... | Exposure { Child..... / Adult..... } | Onset:.....

LOCALIZING SYMPTOMS

	Present illness	Present symptoms
Cough		
Expect		
Hemoptysis		
Str. Sput		
Pleur { Wet		
Pleur { Dry		
Dyspnea		
Pain in chest		
Hoarseness		

CONSTITUTIONAL SYMPTOMS

Temperature range		
Fever		
Pulse range		
Nightsweats		
Chills		
Languor		
Lack of endurance		
Anorexia		
Indigestion		
Loss of weight		

PHYSICAL SIGNS

Except râles..... | Location { Upper..... / Lower.....

Râles ... | Fine | MC | Extent-Turban.....

ROENTGENOGRAM

PB. { Upper..... / Lower..... | PC. { Upper..... / Lower .....

TUBERCLE BACILLI

Previous..... | Date .....

Present..... | Gaffky .....

SKIN TEST

Dose	Reaction after:	Amount	Intradermic	
.....	24 hours....	.....	.....	.....
.....	48 hours....	.....	.....	.....

COMPLEMENT FIXATION

Entrance.... | Exercise..... | Discharged.....

ACTIVITY

	Clinical	Serological	Roentgenogram	Duration
Previous				
Present				

DIAGNOSIS

Tuberculous infection ..... | Dr.....

Clinical tuberculosis ..... | Dr.....

Condition { Active { Previous.. | How long... | Dr.....
Condition { Active { Present... | How long... | Dr.....
Condition { Non-active | Present... | How long... | Dr.....

fixation 30 per cent were active, 60 per cent inactive and 10 per cent questionable, whereas for moderately advanced the figures were 40, 52 and 8 per cent, and for the far advanced 61, 23 and 16 per cent. So as the case advances it is more likely to be active clinically and

serologically. A study of the cases with negative complement fixation shows that little difference exists between the incipient and moderately advanced groups.

DURATION OF THE DISEASE AND COMPLEMENT FIXATION

In an attempt to study the relation of the duration of the disease to positive complement fixation, it became apparent that all cases admitted to Trudeau were supposed to have had more or less recent symptoms that suggested activity. Hence we felt that a study of the duration of disease was of little value in these cases.

CLINICAL DATA AND COMPLEMENT FIXATION

We have again with the larger figures been unable to get any combination of clinical data which would give us more than 95 per cent positive complement fixation (diagnosis positive, activity positive, tubercle bacilli positive, parenchymatous lesion positive.) On the other hand with the diagnosis positive, but without activity, tubercle bacilli or a parenchymatous lesion, we get positive complement fixation in only 24 per cent. In all other combinations that we have studied the complement fixation is positive in a much larger percentage, usually varying between 40 and 60 per cent.

"ACTIVITY" AND COMPLEMENT FIXATION

There is no more important question after a diagnosis of tuberculosis has been made than the determination of the presence or absence of activity. We have endeavored to see if the complement fixation test would throw any light upon this problem so difficult for the clinicians to decide.

Of the patients with a positive diagnosis of tuberculosis we made a diagnosis of clinical activity in 34 per cent, of inactivity in 56 per cent, and of questionable activity in 10 per cent. The complement fixation was positive in 81 per cent when activity was present, in 61 per cent when it was absent and in 79 per cent when its presence was questionable.

PATIENTS WITH NEGATIVE OR QUESTIONABLE DIAGNOSIS OF TUBERCULOSIS

In 62 of the 540 cases a negative or questionable diagnosis was made and in 16 the complement fixation was positive. Of course none of these 62 cases had tubercle bacilli in their sputum, and 13 were thought

TABLE 1
Diagnosis Positive

Activity Positive 164																				
	Tubercle Bacilli +,112									Tubercle Bacilli 0, 52										
	Compl. Fix. +104				Compl. Fix. 0, 8					Compl. Fix. +, 33				Compl. Fix. 0, 19						
	Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total		Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total			
Parenchymatous	47	15	35	97	3	0	2	5	102	6	5	17	28	1	1	8	10	38	140	
Peribronchial	8	0	4	6	0	1	2	3	9	0	3	2	5	2	0	5	7	12	21	
Negative	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1	1	2	2	3	
Total	49	15	40	104	3	1	4	8	112	6	8	19	33	3	2	14	19	52	164	

TABLE 2
Diagnosis Positive

Activity Negative 267																				
	Tubercle Bacilli +,154									Tubercle Bacilli 0, 113										
	Compl. Fix +120				Compl. Fix. 0, 34					Compl. Fix. +, 50				Compl. Fix. 0, 63						
	Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total		Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total			
Parenchymatous	62	19	32	113	12	3	16	31	144	9	5	25	39	9	4	16	29	68	212	
Peribronchial	1	2	3	6	1	1	1	3	9	1	1	9	11	5	0	23	28	39	48	
Negative	1	0	0	1	0	0	0	0	1	0	0	0	0	1	1	4	6	6	7	
Total	64	21	35	120	13	4	17	34	154	10	6	34	50	15	5	43	63	113	267	

TABLE 3
Diagnosis Positive

Activity Questionable. 47																				
	Tubercle Bacilli +, 32									Tubercle Bacilli 0, 15										
	Compl. Fix. +, 27				Compl. Fix. 0, 5					Compl. Fix. +, 10				Compl. Fix. 0, 5						
	Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total		Hem +	S.S. +	Hem 0	Total	Hem +	S.S. +	Hem 0	Total			
Parenchymatous	13	4	7	24	2	0	3	5	29	2	0	7	9	1	1	1	3	12	41	
Peribronchial	2	0	1	3	0	0	0	0	3	0	0	1	1	0	0	0	0	1	4	
Negative	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	
Total	15	4	8	27	2	0	3	5	32	2	0	8	10	1	2	2	5	15	47	

to have some disease which was active. Tweny-five had a negative pulmonary radiograph, while 3 showed a parenchymatous and 36 a peribronchial lesion. The patients with a positive complement fixation included:

1. Two patients with parenchymatous X-ray lesions. One of these had tuberculous cervical glands.
2. Ten patients with peribronchial X-ray lesions.
   a. One had an elevated temperature after discharge.
   b. In a second with endocarditis the staff was divided about the presence of a tuberculous lesion.
   c. Two developed high fever later.
   d. Three were tested with old tuberculin subcutaneously:
      1. One reacted to 10 mg. and had a positive complement fixation just after the tuberculin test, but complement fixation was later again negative.
      2. Another reacted to 5 mg. with 101.3° temperature.
      3. A third had only 0.1 mg. and failed to react but left before a second dose could be given.
   e. Three cases were without symptoms and no explanation could be offered for the positive complement fixation.
3. Four had a negative pulmonary radiograph.
   a. One patient had a uterine curettage before entrance, possibly for a tuberculous condition.
   b. One gave a positive history of tubercle bacilli in the sputum, and temperature rise.
   c. One had a possible hyperthryoidism.
   d. One reacted to 0.1 mg. intradermically.

TABLE 4

Diagnosis Negative or Questionable – 62

	Activity Positive 13									Activity Negative 49									
	Complement Fixation Positive 5				Complement Fixation Negative 8					Complement Fixation Positive 11				Complement Fixation negative 38					
	Hem +	SS +	Hem 0	Total	Hem +	SS +	Hem 0	Total		Hem +	SS +	Hem 0	Total	Hem +	SS +	Hem 0	Total		
Parenchymatous	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	1	3	3
Peribronchial	0	0	4	4	0	0	2	2	6	1	1	4	6	3	1	20	24	30	36
Negative	0	0	1	1	0	1	5	6	7	2	0	1	3	3	1	9	13	16	23
Total	0	0	5	5	0	1	7	8	13	3	1	7	11	7	2	29	38	49	62

BRONCHIAL ULCERATIONS AND COMPLEMENT FIXATION

A year ago we called attention to the fact that complement fixation was much more likely to be positive in patients when bronchial ulceration was present. We have accepted the occurrence of tubercle bacilli in the sputum at any time as indicative of bronchial ulceration. In patients with activity the chances were 13 to 1 that complement fixation would be positive if bronchial ulceration were present, while when no tubercle bacilli were found the chances were better than 2 to 1 that complement fixation would be positive. In patients without activity the chances that complement fixation would be positive were $3\frac{1}{2}$ to 1 when bronchial ulceration had occurred, and less than even (5 to 4) when no tubercle bacilli had been found. Again, where the presence of activity was questionable, the chances of a positive complement fixation was $5\frac{1}{2}$ to 1 with bronchial ulceration and only 2 to 1 without it.

Not all patients who have had tubercle bacilli in the sputum at some time reacted positively to the complement fixation test. In fact 47 (9.8 per cent) of the 478 such patients failed to react,—(activity positive, 8; activity negative, 34; activity, questionable, 5).

POSITIVE SPUTUM AT THE TIME OF COMPLEMENT FIXATION TEST

In a study of 139 cases where tubercle bacilli were positive on admission, complement fixation was positive on admission in 90 per cent. When the cases in this group with positive activity were considered alone, the complement fixation was positive in 98 per cent, but fell to 82 per cent when no activity was present.

BLOOD-SPITTING AND COMPLEMENT FIXATION

In active cases the chance that a case has a positive complement fixation test is 12 to 1 if he has spat blood, but only 4 to 1 if no blood spitting has occurred. In patients without activity, the ratios are 3 to 1 and 5 to 4.

If we consider blood-spitting as a sign of bronchial ulceration and compare it with the results obtained in the study of the occurrence of tubercle bacilli in the sputum, we find that in regard to the complement fixation test the presence or absence of bronchial ulceration as indicated by tubercle bacilli, is of much more moment than

when indicated by blood spitting. In patients in whom tubercle bacilli have not occurred (activity and a parenchymatous lesion being present) complement fixation is positive in 85 per cent of the cases with hemoptysis and in 64 per cent of those without.

Considered from another point of view, 80 per cent of the instances of hemoptysis and 83 per cent of the instances of streaked sputum occurred in patients with a positive complement fixation. In all other instances we have not separated hemoptysis from streaked sputum, but have considered both under the head of hemoptysis.

EXERCISE AND COMPLEMENT FIXATION

The value of the complement fixation test in ordering the life of the patient has long seemed very important, and we hoped would throw some light upon this difficult subject. At first we divided the patients (382) according to the amount of exercise prescribed into three groups:

1. Those taking one-fourth to one-half hour once or twice a day.
2. Those with three-fourths hour.
3. Those with one hour or more exercise.

No conclusions were drawn from this and we next attempted to see the results of exercise. Here we separated those in whom exercise had no effect (314-82 per cent) from those where untoward effects apparently resulted from the exercise (68—18 per cent). In prescribing exercise we ignored for the most part the complement fixation test, for we wished to see if it were really of value.

Apparently when complement fixation is positive on admission, patients with activity positive or questionable will do equally well on exercise (17 per cent with bad effects) while those with no activity do relatively worse (29 per cent). Put in another way, 11 per cent of those with bad effects and 40 per cent with no effects had a negative complement fixation on admission. It is not impossible that more or less unintentionally we increased the exercise more rapidly in patients with a negative complement fixation, in order to test its value in clinical work.

When the complement fixation on admission was negative the 90 patients with activity questionable all had no bad effects from exercise, while 18 out of 19 (95 per cent) with activity positive, and 9 out of 11 (82 per cent) with activity negative had no effects. Here

TABLE 5

Relation of Complement Fixation to Exercise

		Exerc.	CF++ Act+	C.F. +,+, Act. 0	C.F. +,+, Act. ?	C.F. +,0, Act.+	C.F. +,0, Act.0	C.F. +,0, Act.?	CF 0,+	C.F. 0,0, Act.+	C.F. 0,0, Act 0	CF 0,0, Act.?	Total
No exercise			24	10	3	5	5	0	4	3	6	0	60
Bad Effect	Temp. 24	¼-½ h	6	6	0	0	4	0	1	0	1	0	18
		¾ h	1	0	1	0	0	0	0	0	0	0	2
		1 h	0	3	0	0	1	0	0	0	0	0	4
		Total	7	9	1	0	5	0	1	0	1	0	24
	Hem. 10	¼-½ h	4	0	2	0	1	1	0	0	0	0	8
		¾ h	0	0	0	0	0	0	0	0	1	0	1
		1 h	0	0	0	0	1	0	0	0	0	0	1
		Total	4	0	2	0	2	1	0	0	1	0	10
	S S. 18	¼-½ h	0	3	0	0	2	0	1	0	0	0	6
		¾ h	2	3	0	0	1	0	0	0	0	0	6
		1 h	1	4	0	0	0	0	1	0	0	0	6
		Total	3	10	0	0	3	0	2	0	0	0	18
	Gen Sym 16	¼-½ h	0	4	1	2	0	0	2	1	0	0	10
		¾ h	0	4	0	0	1	0	0	0	0	0	5
		1 h	0	1	0	0	0	0	0	0	0	0	1
		Total	0	9	1	2	1	0	2	1	0	0	16
			14	28	4	2	11	1	5	1	2	0	128
No Effect	No Sym 175	¼-½ h	7	3	2	5	9	3	0	3	17	1	50
		¾ h	2	6	1	1	5	0	1	2	12	0	30
		1 h	7	10	3	6	19	2	3	7	35	3	95
		Total	16	19	6	12	33	5	4	12	64	4	175
	Pleur. 100	¼-½ h	8	1	1	6	3	2	2	1	2	2	28
		¾ h	4	5	0	2	2	0	1	2	4	0	20
		1 h	9	9	1	1	7	3	0	3	17	2	52
		Total	21	15	2	9	12	5	3	6	25	4	100
	Hem. 15	¼-½ h	1	3	1	0	0	0	0	0	0	0	5
		¾ h	2	2	0	0	0	0	0	0	0	0	4
		1 h	2	2	0	0	1	0	0	0	1	0	6
		Total	5	7	1	0	1	0	0	0	1	0	15
	S.S. 24	¼-½ h	1	2	1	0	2	1	0	0	1	1	9
		¾ h	2	0	0	0	1	0	0	0	0	0	3
		1 h	3	2	3	0	2	0	1	0	1	0	12
		Total	6	4	4	0	5	1	1	0	2	1	24
			48	45	13	21	51	11	8	18	90	9	314
Grand Total			62	73	17	23	62	12	13	19	92	9	442

again, those with activity negative did less well, presumably for the reason we have stated.

Only 3 out of 12 patients have had bad effects from exercise with complement fixation negative on admission.

(If we add additional data to this we get 8 with bad effects out of 133 cases.)

On the other hand 60 out of 249 patients with complement fixation positive on admission had bad effects.

When activity was positive on admission and bad effects followed exercise, 94 per cent had a complement fixation positive on admission (16 out of 17), whereas if no effect resulted from exercise 79 per cent had complement fixation positive on admission.

These figures indicate to us that complement fixation yields more information concerning the effects of exercise as prescribed in these cases than the clinical activity determined by the methods we have indicated. Whereas 24 per cent with complement fixation positive on admission had bad effects following exercise, only 6 per cent with complement fixation negative had bad results. A negative complement fixation test seems therefore to us to be of more value in relation to exercise in patients than a positive complement fixation and patients with complement fixation negative can be allowed to exercise much more freely than those with complement fixation positive (among whom possibly one-half will show some untoward effects following exercise).

INTRADERMIC TUBERCULIN TEST AND COMPLEMENT FIXATION

A year ago we stated that the complement fixation test and cellular hypersensitiveness as manifested by the intradermic reaction to old tuberculin did not run a parallel course. Further experience confirms this. If we divide our cases into 3 groups:

1. Complement fixation positive on admission and discharge, and activity positive on admission;

2. Complement fixation positive on admission and discharge, and activity negative on admission, and

3. Complement fixation negative on admission and discharge, and activity negative,

we find that 82 per cent of the first, 81 per cent of the second and 75 per cent of the third group reacted intradermically to 0.0001 cc. or less of old tuberculin.

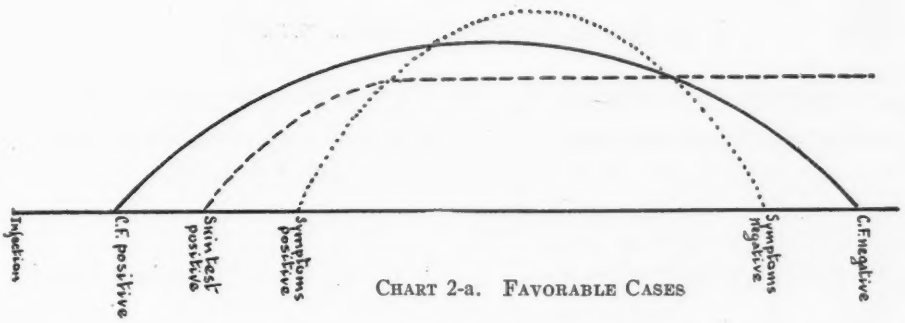

CHART 2-a. FAVORABLE CASES

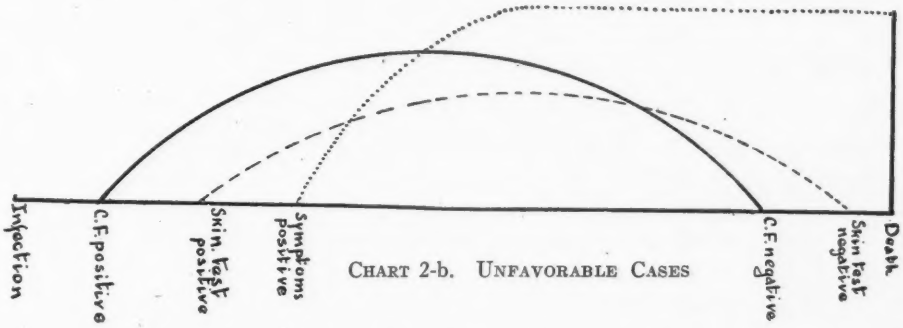

CHART 2-b. UNFAVORABLE CASES

CHART 2. CLINICAL TUBERCULOSIS

The time after infection at which the complement fixation test first becomes positive has never been determined in man. Hamburger in Germany and Hess in New York have in infants found that the tuberculin reaction occurs 1 to 2 months after probable infection. The complement fixation test is probably positive before symptoms develop. When symptoms do not occur the complement fixation test and the tuberculin reaction are practically always present. Cellular hypersensitiveness to tuberculin persists much longer than the presence of detectable "antibodies" in the serum.

There is some evidence to show that the complement fixation test becomes negative one and one-half to two years after the disappearance of symptoms (Baldwin).

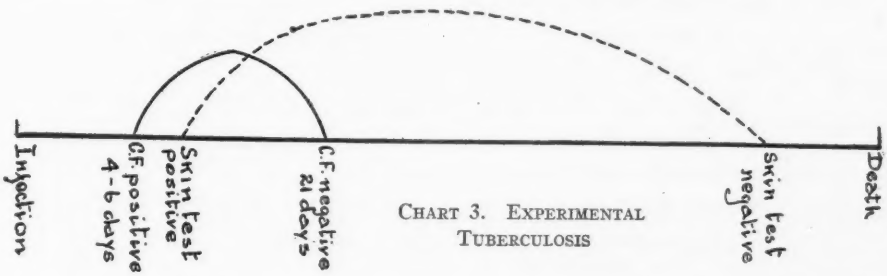

CHART 3. EXPERIMENTAL TUBERCULOSIS

In the guinea-pig the complement fixation test becomes positive in four to six days* after infection and in three weeks is negative and remains so. The tuberculin reaction becomes positive in about two weeks and disappears before death. The abscissa represents time.

* Besredka first noted this and we have confirmed it.

SUBCUTANEOUS TUBERCULIN TEST AND COMPLEMENT FIXATION

Thirty cases were studied and the results are given under the doses of old tuberculin to which they reacted or failed to react.

1. Ten "milligrams"—14 cases.
   - 14 failed to react.
     - 12 had complement fixation negative on admission and discharge.
     - 1 had complement fixation negative on admission and discharge but complement fixation was positive after the tuberculin reaction.
     - 1 had a positive complement fixation on admission and discharge and had had a uterine curettage before admission.
2. Five "milligrams"—5 cases.
   - 1 failed to react and the complement fixation was negative on admission and discharge.
   - 4 reacted.
     - 2 had a complement fixation positive on admission and negative on discharge.
     - 2 had a negative complement fixation on admission and discharge.
3. Three "milligrams"—7 cases.
   - 1 failed to react and had a negative complement fixation on admission and discharge.
   - 6 reacted.
     - 5 had a negative complement fixation on admission and discharge.
     - 1 was negative on admission, (only time performed).
4. One "milligram"—2 cases.
   - Both reacted, and had negative complement fixation on admission and discharge.
5. One-tenth "milligram"—2 cases.
   - Both reacted and had a positive complement fixation on admission and negative on discharge.

PLEURISY WITH EFFUSION

Of six cases studied four were negative in regards to complement fixation, though one had positive tubercle bacilli. One had, however, the effusion one year previous to the test. In one case with comple-

ment fixation positive, pleural effusion occurred later and one case with a positive complement fixation on admission and discharge had pleural effusion previously.

ARTIFICIAL PNEUMOTHORAX

In the 3 cases studied no change occurred following the operation.

OTHER DISEASES

MALIGNANCY

In these cases the complement fixation was always negative.

CARDIAC DISEASES

In 3 cases the complement fixation was negative, while in a fourth it was positive on admission and discharge. Tuberculosis was suspected and had been diagnosed in this patient.

TYPHOID FEVER

No change occurred in the complement fixation test in 3 typhoid fever cases who also had tuberculosis.

WASSERMANN TEST

This test was done in conjunction with every complement fixation test for tuberculosis, and was found positive in only 13 cases; 7 of these cases were diagnosed as having tuberculosis also.

The occurrence of a positive Wassermann test seems to have no influence on the complement fixation test for tuberculosis.

CHANGES IN THE COMPLEMENT FIXATION DURING SANATORIUM RESIDENCE

It is of interest to see in what percentage of cases in these groups the complement fixation changes from positive to negative or from negative to positive or indeed remains unchanged during a residence of some 3 to 6 months.

TABLE 6

Comparison of complement fixation test on admission and discharge

	NO CHANGE	POSITIVE TO NEGATIVE	NEGATIVE TO POSITIVE
Incipient	76 (70 per cent)	30 (28 per cent)	2 (2 per cent)
Moderately advanced	215 (74 per cent)	63 (22 per cent)	11 (4 per cent)
Far advanced	13 (81 per cent)	2 (13 per cent)	1 (6 per cent)

These changes are exactly what we would expect in regard to the groups, but we were somewhat surprised that only 30, 26 and 19 per cent, respectively, showed a change in the complement fixation test.

Into the group with a positive complement fixation on admission and discharge fell 23 per cent of the incipient, 51 per cent of the moderately advanced and 62 per cent of the far advanced.

Into the group with a negative complement fixation on admission and discharge fell 47 per cent of the incipient, 23 per cent of the moderately advanced and 13 per cent of the far advanced.

A COMPARATIVE STUDY OF ANTIGENS

This past year one of us (Petroff) has used a new antigen, a glycerine extract of tubercle bacilli, which he has described in detail elsewhere. We have endeavored to compare this with the old "potato

TABLE 7

Relation of Complement Fixation to Condition on Admission and Discharge

Condition on Admission	Condition on Discharge	C F +,+ Act.+	C F +,+ Act. 0	C F. +,+ Act.?	C F. +,0, Act.+	C F. +,0, Act. 0	C F +,0, Act.?	C.F. 0,+,	C F 0,0, Act.+	C F 0,0, Act.,0	C F. 0,0, Act ?	Total
Incipient 108	App Arrest	2	2	0	2	8	2	1	3	20	1	41
	Quiescent	4	5	1	5	8	2	0	3	14	1	45
	Improved	1	4	1	0	2	0	0	2	3	0	13
	Un-impr-v-d	1	4	0	1	0	0	1	0	3	1	11
	Total	8	15	2	8	18	4	2	8	40	3	108
Mod Adv. 289	App Arrest	3	0	0	1	6	1	0	2	9	0	22
	Quiescent	34	41	7	12	30	2	8	5	39	1	179
	Improved	7	11	1	2	4	0	3	2	6	1	37
	Un-impr-v-d	25	13	5	0	5	0	0	0	2	1	51
	Total	69	65	13	15	45	3	11	9	56	3	289
Far Adv 16	Quiescent	3	1	1	1	0	0	1	0	2	0	9
	Improved	3	0	1	0	0	0	0	0	0	0	4
	Un-impr-v-d	1	1	0	0	1	0	0	0	0	0	3
	Total	7	2	2	1	1	0	1	0	2	0	16
	Grand Total	84	82	17	24	64	7	14	17	98	6	413

filtrate" and "NaOH" extract. We have come to believe without quoting more confusing figures that the glycerine extract gives the greatest number of positive tests in tuberculosis, and the "potato filtrate" more than the "NaOH." Each in turn has failed to give a positive test in some cases in which one or the other did so. Consequently, while we believe the glycerine extract the best, we do not yet feel that it can be used to replace either of the others and that

TABLE 8

Complement fixation test on admission and discharge

	ADMISSION	DISCHARGE	INCIPIENT	MODERATELY ADVANCED	FAR ADVANCED
			per cent	*per cent*	*per cent*
Complement fixation	Positive	Positive	23	51	69
Complement fixation	Negative	Negative	47	23	12
Complement fixation	Positive to negative		28	22	13
Complement fixation	Negative to positive		2	4	6

when all three antigens are used the largest number of positive fixations are obtained.

CONCLUSIONS

In conclusion we believe that

1. A positive complement fixation indicates that antibody is or has recently been circulating in the blood stream.

2. The far advanced cases react positively more frequently to the complement fixation test than the moderately advanced and the moderately advanced than the incipient.

3. Only one combination of clinical data predicts fairly closely (95 per cent) the presence of a positive complement fixation test.

4. A complement fixation test is more likely to be positive when tubercle bacilli have been found in the sputum than when hemoptysis without tubercle bacilli has occurred.

5. All patients with tubercle bacilli in the sputum at the time of the test do not react positively to the complement fixation test (about 10 per cent are negative).

6. Patients with a negative complement fixation test do far better on exercise than those with a positive reaction.

7. The complement fixation test and the intradermic tuberculin reaction do not run a parallel course. The latter is far more persistant.

8. The subcutaneous tuberculin reaction and the complement fixation test do not run parallel courses. Many patients react to the tuberculin and have a negative complement fixation test. The opposite may occur.

9. Patients with pleurisy with effusion do not react readily to the complement fixation test.

10. The presence of a positive Wassermann test has no bearing upon the complement fixation test in tuberculosis.

11 Only one-third of the incipient, one-fourth of the moderately advanced, and one-fifth of the far advanced cases show any change in their reaction to the complement fixation test during an average residence of five to six months.

12. The best antigen so far used is the glycerine extract of the tubercle bacilli, but no antigen yet discovered produces 100 per cent of positive reactions in patients.

13. A positive complement fixation test suggests observation of the patient for a time.

14. The complement fixation test is of value to the clinician, and like the subcutaneous tuberculin test, is of more value when it is negative than when positive in the determination of what patients need treatment.

THE COMPLEMENT FIXATION TEST FOR TUBERCULOSIS[1]

LINDA B. LANGE

From the Kenneth Dows Fund for the Study of Tuberculosis of the Medical Clinic of the Johns Hopkins University and Hospital, Baltimore, Maryland

Over a year ago a series of complement fixation tests for tuberculosis was begun at the Tuberculosis Laboratory of the Johns Hopkins Hospital and Medical School. Dr. A. S. Rothholz, as well as Miss Isabel Wasson, Mr. J. E. Elmendorf and Mr. L. T. Davidson, of the Johns Hopkins Medical School assisted in the work. Most of the sera were from patients in the Johns Hopkins Hospital and its dispensary, but by far the greater number of sera from cases of clinical tuberculosis were obtained through the courtesy of Dr.. Martin F. Sloan, from the Eudowood Sanatorium.

The hemolytic system was the usual one consisting of a 5 per cent suspension of sheep cells in 0.85 per cent sodium chloride, 10 per cent guinea pig serum for complement, and inactivated serum from a rabbit immunized against washed sheep red blood cells as amboceptor. Patients' sera were removed from the clots as soon as possible and inactivated in the water bath for one-half hour at 55°C. Sera used on subsequent days as controls were again inactivated for five minutes previous to use. Four antigens were used, the bacillary suspension of Miller and the sodium hydroxide extract, the methyl alcohol extract and the potato broth culture filtrate of Petroff. Doctor Miller kindly sent us some of his antigen at the beginning of our work, and at a later time some moist autoclaved cultures of a strain of tubercle bacilli he considered to have strong antigenic properties. For the rest the Miller's antigen was made in our laboratory with the H 37 strain of the Saranac Laboratory. We are also indebted to Mr. Petroff for a certain quantity of each of his three antigens which were used in the first tests. Later these antigens were made in our laboratory according to his directions, and using the H 37 strain of tubercle bacilli. In the test the reagents were used in the following quantities; sheep

[1] Read before the Pathological Section at the Fourteenth Annual Meeting of the National Tuberculosis Association, Boston, Massachusetts, June 7, 1918.

cells, 0.25 cc.; complement, 2 units; amboceptor, 2 units; patient's serum, undiluted, 0.05 cc.; and 0.85 per cent sodium chloride to make up the total volume to 1.0 cc. Preliminary titrations of complement and of amboceptor were made each day. The patient's serum with antigens, complement and saline solution, were incubated in the water bath at 37.5°C. for one hour, the hemolytic system added and the tests returned to the water bath to be read when the controls cleared, usually after fifteen minutes of further incubation. Controls were run for the hemolytic system, each antigen, known positive and negative sera for each antigen, and for the patient's serum. The substance to be controlled in each case was used in twice the quantity employed in the test. Complete fixation was recorded as ++++; incomplete fixation down to one-half hemolysis as +++; all lesser fixations were grouped together; and complete hemolysis recorded as 0.

A total of eight hundred and fifty six sera are reported on in this paper. Table 1 presents a summary of the results. Tuberculous sera gave 51.5 per cent of fixations of any degree, while non-tuberculous sera gave 13.6 per cent of fixations. The proportion of higher fixations was greater with sera from clinically tuberculous cases. Table 2 gives a further analysis of the positive reactions classified according to antigens. It should be remembered that a given serum may react in varying degree to the different antigens. The apparent discrepancy between the number of sera listed in the two tables is due to the fact that not every serum was tested with each antigen, and therefore, for comparison, the results are given in terms of per cent. The alcoholic antigen gave the highest percentage of strong fixations in clinically tuberculous cases and the sodium hydroxide antigen, the lowest. With the sera from non-tuberculous cases the greatest proportion of strong fixations was obtained with the sodium hydroxide antigen and the smallest with the potato filtrate antigen. A further analysis of the binding properties of the antigens is given in Table 3. All tend to give a greater percentage of strong fixations with the sera of more advanced active pulmonary cases than with those of the less advanced.

The non-tuberculous medical cases withs ingle diagnoses and without complications are listed in table 4, with a record of the number giving any degree of fixation with any antigen as well as the number and degree of fixation obtained with the different antigens.

One hundred and forty-seven sera giving a positive Wassermann reaction were tested with the tuberculosis antigens. A tabulation of the

results is given in table 5. Ten sera from patients free from clinical syphilis or tuberculosis gave fixations and twelve from patients in whom there was clinical syphilis but no clinical tuberculosis.

TABLE 1

Summary of results of tests in clinically tuberculous and non-tuberculous cases

NUMBER OF SERA	CLINICAL TUBERCULOSIS	FIXATION ANY DEGREE	GREATEST DEGREE OF FIXATION WITH ANY ANTIGEN			
			++++	+++	++	0
173	+	+ in 89 or 51.5 per cent 0 in 84 or 48.5 per cent	47	14	28	84
683	0	+ in 93 or 13.6 per cent 0 in 590 or 86.4 per cent	24	10	59	590

TABLE 2

Analysis of fixations obtained with the different antigens in clinically tuberculous and non-tuberculous cases

CLINICAL TUBERCULOSIS	MILLER					NaOH					ALCOHOL					POTATO FILTRATE				
	Number of sera tested	++++	+++	++	0	Number of sera tested	++++	+++	++	0	Number of sera tested	++++	+++	++	0	Number of sera tested	++++	+++	++	0
		per cent	per cent	per cent	per cent		per cent	per cent	per cent	per cent		per cent	per cent	per cent	per cent		per cent	per cent	per cent	per cent
+	87	19	13	31	37	85	12	16	31	41	76	45	8	25	26	73	15	9	36	40
0	79	10	7	43	40	90	18	3	41	37	88	12	8	31	48	43	3	5	19	72

TABLE 3

Fixations with sera from classified cases of clinical tuberculosis

TYPES OF TUBERCULOUS PROCESS	NUMBER OF FIXATIONS OBTAINED															
	Miller				NaOH				Alcohol				Potato filtrate			
	++++	+++	++	0	++++	+++	++	0	++++	+++	++	0	++++	+++	++	0
Pulmonary, incipient	1	1	1	9				9	3	1	1	6			1	8
Pulmonary, moderately advanced	7	3	9	49	3	10	1	41	13	2	10	37	5	4	13	38
Pulmonary, far advanced	6	4	15	27	4	2	13	35	18	3	6	23	6	3	11	20
Pulmonary, arrested			1		1		11					1				1
Meningitis				2	1			2	1			2				
Surgical	1			9	1		1	7				7			1	1

TABLE 4

	NUMBER OF SERA TESTED	NUMBER OF SERA GIVING FIXATION	MILLER			NaOH			ALCOHOL			POTATO FILTRATE		
			++++	+++	++	++++	+++	++	++++	+++	++	++++	+++	++
Anaemia, primary	5	0												
Asthma, bronchial	5	1						1						
Cholelithiasis	2	0												
Diabetes	12	1						1						
Endocarditis, chronic	6	2		1	1	1								
Hodgkin's disease	3	0												
Hypertension, essential	6	1						1						
Infections, miscellaneous. acute	24	7	2		2	1		2						
Infections, miscellaneous, chronic	34	2	2		2			2		1	1			
Jaundice, congenital haemolytic	3	0												
Leukaemia, acute	1	0												
Lymphosarcoma	1	1						1						
Measles	2	0												
Meningitis, ac. epid. cer. sp.	1	0												
Myocarditis, chronic	3	0												
Nephritis, acute	3	1	1			1								
Nephritis, chronic	13	2						1						1
Neurological disease:														
Amyotrophic lateral sclerosis	1	0												
Chorea	1	0												
Epilepsy	5	1	1			1								
Multiple sclerosis	4	0												
Trigeminal neuralgia	2	0												
Pneumonia, acute broncho-	1	0												
Pneumonia, acute lobar	29	10			8	1		4		1	2			1
Poliomyelitis, acute	1	0												
Polycythaemia	1	0												
Poisoning, benzol	2	1									1			
HgCl	1	1			1	1								
Rheumatic fever	5	2			1			1			2			1
Syphilis	49	3		1				2						
Tetanus	1	0												
Tetany	1	0												
Tumors:														
Carcinoma	13	1						1						
Myoma uteri	1	0												
Sarcoma	4	0												
Of abdomen	1	0												
Of brain	4	1						1						
Of liver	1	1			1						1			
Of mediastinum	2	0												
Of parotid	1	0												

TABLE 4—*Continued*

	NUMBER OF SERA TESTED	NUMBER OF SERA GIVING FIXATION	MILLER			NaOH			ALCOHOL			POTATO FILTRATE		
			++++	+++	++	++++	+++	++	++++	+++	++	++++	+++	++
Typhoid fever	9	0												
Typhus fever	1	1						1			1			
Parasites and protozoan infection:														
Amoebic dysentery	2	0												
Ascaris	1	0												
Echinococcus cyst of liver	1	1			1									
Malaria	3	0												
Uncinariasis	1	0												

TABLE 5

Summary of results of tests of sera giving a positive Wassermann reaction

POSITIVE WASSERMANN SERUM	TUBERCULOSIS COMPLEMENT FIXATION	CLINICAL TUBERCULOSIS	GREATEST DEGREE OF FIXATION WITH ANY ANTIGEN				REMARKS
			++++	+++	+ ++	0	
147	+ in 26 or 18.7 per cent	+4		1	2		Clinical syphilis
					1		No history of syphilis
		−22	4	1	7		Clinical syphilis
			3	2	5		No history of syphilis
	0 in 121 or 82.3	+1				1	
		−120				120	

THE VALUE OF TUBERCULOSIS COMPLEMENT FIXATION IN CLINICAL TUBERCULOSIS

B. STIVELMAN

From the Montefiore Home Country Sanatorium, Bedford Hills, New York

The early determination of the clinical importance of the tuberculous foci which most of us are supposed to harbor is admittedly one of the most important and difficult problems in clinical medicine. Indeed, in many cases, the available data are so indefinite and at times conflicting that with all methods on hand, we frequently fall short of making a positive diagnosis, or make a positive diagnosis which perhaps was not justified.

It was but natural, therefore, for us to turn with great interest to the subcutaneous injection of old tuberculin, at first heralded as the most reliable diagnostic test for early clinical tuberculosis. Time, however, has since demonstrated the limited usefulness of this test. It is not applicable in febrile and hemorrhagic cases, diabetes, nephritis, in cases with cardiac complications, and in pregnant women.

The anaphylaxis on which the test is said to depend is not at all devoid of danger. In fact clinicians agree that in many cases its deleterious effects are pronounced and lasting. But were the test absolutely harmless, what reliance can be placed on it when looking for clinically active tuberculosis? We know that about 90 per cent of adults have already been infected with tuberculosis as proved by the von Pirquet cutaneous reaction (1) and autopsy findings (2).

Fishberg (3) asserts that between 40 per cent and 60 per cent of human beings react to the subcutaneous tuberculin test, provided it is repeated with ascending doses three or four times.

Simon (4) claims that 56 per cent of non-suspected cases give a positive reaction to the subcutaneous test. Careful investigation by Franz (5), Beck (6), Hamman and Wollman (7), show that a positive subcutaneous tuberculin reaction may be obtained in healthy individuals who do not subsequently develop phthisis and the specificity of the reaction has been questioned in recent years, as shown by the experiments of

Mettetal (8) and Petruschky (9). It has been demonstrated that tuberculous people acquire a definite hypersensitiveness to all kinds of foreign proteins, tuberculous and non-tuberculous.

We therefore looked forward with great hope to the tuberculosis complement deviation test in the diagnosis of clinical tuberculosis. Its harmlessness and wider range of application were apparent, and its absolute specificity was assured by many writers, since it is claimed that this reaction is dissimilar to the Wassermann reaction, wherein lipoid bodies which may not be of syphilitic origin, may bind the complement.

In the tuberculosis complement fixation test the complement is said to be bound by specific bodies produced by the irritation of the endotoxins and possibly the exotoxins emitted through the metabolism and disintegration of the tubercle bacilli.

Since as clinicians our attention is directed to tuberculous disease and not to tuberculous infection, the question arises, "Does a positive tuberculosis fixation signify clinical tuberculosis?" Our experience with this test has shown that this question has not been answered.

Tuberculosis complement fixation was first applied by Widal and Le Sourd (10). In 1903 Bordet and Gengou (11) demonstrated the usefulness of this test. It was not until 1911, however, that Caulfield (12), using an emulsion of tubercle bacilli, examined 104 cases of pulmonary tuberculosis, and obtained positive results in 33 per cent Turban I, 70 per cent Turban II, and 62 per cent Turban III cases. Since then many workers have reported their experience with this test, notable among whom are the following:

Craig (13), using a filtrate antigen reports two positive reactions in 350 non-tuberculous cases. Of 107 active cases, 103 or 95 per cent reacted positively. Of 59 inactive cases, 39 or 66 per cent reacted positively. Bronfenbrenner (14), using the Besredka antigen reports 61 out of 65 active cases, or 94 per cent reacted positively while 15 out of 27 inactive cases or 55 per cent gave a positive reaction.

McCaskey (15), using an antigen similar to Craig's, reports 22 out of 36 clinically diagnosed cases with a negative sputum, or 77 per cent, giving positive results, and 15 out of 74 non-tuberculous cases, or 20 per cent, giving positive reactions.

Miller (16), using a polyvalent bacillary emulsion, reports 98 per cent positive reactions in clinically active cases and 92 per cent negative results in clinically inactive cases.

Alfred Meyer (17), reports 15 out of 22 cases of various non-tuberculous diseases, equalling 68 per cent, the negative complement fixation of which agreed with the clinical findings.

Shield (18) reports 8 known tuberculous cases whose blood was negative to the test and 12 out of 23 suspected cases the blood of which gave a positive reaction.

In our series of 205 cases, 22 of which were clinically non-tuberculous, Miller's antigen was used exclusively. A Wassermann reaction was done in each case as a routine measure and we found but 4 out of the 205 cases giving a positive Wassermann reaction. These cases, however, were tuberculous but free from clinical lues, and also denied luetic infection at any time.

The following tables represent the results obtained:

TABLE 1

Tuberculosis complement fixation in relation to the activity of the disease process

	TOTAL CASES	POSITIVE FIXATION	PER CENT	NEGATIVE	PER CENT
Active	107	55	51.4	52	48.6
Inactive	76	40	52.6	36	47.4

From the foregoing it is evident that active and inactive cases alike, will give about 50 per cent positive reactions, in spite of the fact that

TABLE 2

Results of tuberculosis complement fixation in pulmonary tuberculosis with reference to bacilli in the sputum

	TOTAL CASES	POSITIVE FIXATION	PER CENT	NEGATIVE FIXATION	PER CENT
Sputum positive	107	67	62.6	40	37.4
Sputum negative	76	28	36.8	48	63.2

TABLE 3

Results of the tuberculosis complement fixation test with reference to activity and the presence or absence of bacilli in the sputum

		POSITIVE FIXATION	PER CENT	NEGATIVE FIXATION	PER CENT
Active, 107	Sputum positive, 82	48	58.5	34	41.5
	Sputum negative, 25	7	28.0	18	72.0
Inactive, 76	Sputum positive, 25	19	74.0	6	26.0
	Sputum negative, 51	21	41.0	30	59.0

specific antibodies would be expected to be found very frequently in active cases.

From the above we learn that 41 per cent of active tuberculous cases with positive sputum and 72 per cent of active cases with negative sputum showed a negative tuberculosis fixation reaction. The result is most astonishing, inasmuch as the above were all sthenic cases and should have been able to produce antibodies sufficient to bind the complement satisfactorily.

TABLE 4

Results of tuberculosis fixation test with reference to stage of disease and activity

CLASS		TOTAL	POSITIVE FIXATION	PER CENT	NEGATIVE FIXATION	PER CENT
Incipient, 57	Active	19	3	15.8	16	84.2
	Inactive	38	14	39.5	24	60.5
Moderately advanced, 82	Active	51	27	52.9	24	47.1
	Inactive	31	21	67.7	10	32.3
Far advanced, 44	Active	34	23	67.3	11	32.7
	Inactive	10	7	70.0	3	30.0

From the foregoing some interesting facts may be learned:

1. A positive reaction is obtained more frequently as the disease progresses.
2. The active cases give no more positive reactions than the inactive cases.
3. In early cases the percentage of positive reactions obtained is exceedingly low.

TABLE 5

Results of tuberculosis fixation test in clinically non-tuberculous cases

NON-TUBERCULOUS	POSITIVE	PER CENT	NEGATIVE	PER CENT
22	7	32.0	15	68.0

DISCUSSION

The tuberculosis fixation test, in order to be of service, should bind the complement in those border line cases, wherein clinical activity is present to a certain degree with doubtful physical findings.

We do not need its assistance in cases exhibiting marked physical signs, tubercle bacilli in the sputum and marked constitutional symptoms. To be of use clinically, the test should be most frequently nega-

tive in inactive cases in whom the tuberculous foci are dormant, and whose blood is charged with but little specific antibodies. This it has so far failed to do.

Bronfenbrenner gets a positive reaction in 55 per cent of inactive cases; Craig, in 66 per cent; and McCaskey in 20 per cent non-tuberculous cases; and in our series 52 per cent of our inactive cases and 32 per cent of non-tuberculous cases gave a positive test.

We have been unable to find corroboration of the results obtained by Miller in the literature on the subject. His reports are most astonishing inasmuch as clinical activity could positively be diagnosed were we to get similar results in inactive cases.

CONCLUSION

Our experience shows that the tuberculosis fixation test, when negative, does not necessarily exclude the presence of clinical tuberculosis and when positive does not signify the presence of clinical tuberculosis. It gives us no better information than the subcutaneous tuberculin test.

I wish to express my indebtedness to Drs. Alfred Meyer and M. Taschman from whose services the material was taken, and to Dr. S. Wachsman, Medical Director of the Montefiore Home, for his coöperation in making the tests possible.

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A MANUAL OF THE ROENTGENOLOGICAL EXAMINATION OF THE CHEST

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The roentgenological examination of the chest should consist either of the fluoroscopic or the stereoscopic method. The single plate adds practically nothing to the fluoroscope, as it has the disadvantage of being unable to show motion or to permit the examination of the chest from various angles. The stereoscopic method has the unique advantage of definitely locating the lesions with regard to the three dimensions of their position in the thorax, and allows a detailed study of the character and distribution of the abnormal densities.

An X-ray plate is a record of differing densities. Its value depends solely upon the clinician's ability to determine increased and decreased densities as compared with the normal densities and to deduce what lesions cause such changes.

These fundamental facts must constantly be borne in mind when reading an X-ray plate, no matter whether we are attempting to study bones or the thoracic viscera. The technique necessary to obtain such a record is embodied under three heads—the quality of the rays, the time of exposure, and the relation of patient to the tube and plate. With this technical knowledge in hand physicians must familiarize themselves with the anatomical structures which go to make up the normal variations of density, and determine which structures cause each density. The record of these normal variations of density, obtained by a certain definite technique, I have called the norm, as it is the basis of comparison of densities and, therefore, of the reading or interpreting of all plates. Obviously if you change the technique of exposure you rearrange your record of anatomical densities, and your established norm becomes useless.

To know that a pathological density exists and to accurately localize that density is the primary function of the roentgenologist. Many lesions cause a decreased density (pneumothorax) while many others cause an increased density (pleural effusion).

The working out of an intelligent diagnosis, therefore, is similar to the working out of the unknown in a given chemical problem. If we utilize the X-ray to determine whether we are dealing with increased or decreased density by comparing it with a known norm we at once eliminate a large number of our possible unknowns. This presupposes a knowledge of what lesions produce an increased and what a decreased density. When a lesion has a characteristic distribution the roentgenologist may sometimes even go further and make a diagnosis from this first step (the plate) alone. Concretely this is what happens when fractures are diagnosed directly from the plate.

Given a fracture, it is also necessary to know whether the pathological condition of the bone (bone cyst or sarcoma) predisposes to the break. In other words a diagnosis is not correct unless it is complete, any more than our elementary problem in chemistry is completed until we have found all of the unknowns. The thoracic problem is a complicated one. A complete diagnosis may be made but should not be expected from the roentgenologist. He has done his work well provided he has detected and localized the abnormal densities which exist in a given part.

Thus he should give the clinician, not a diagnosis based upon etiology and pathology, but a diagnosis based upon different densities. From this the clinician eliminates many possible diagnoses and then by applying his clinical symptoms, his physical signs, his laboratory methods, and the history of his case, he works out the other unknowns.

I maintain that so much can be learned in diseases of the thorax by the intelligent study of abnormal densities that no chest examination is complete without this aid.

Our problem lies with the lungs and our principal problem is with tuberculosis of the lung. It is my purpose to accurately describe the technique I have selected as giving best a definite norm, with which the record of pathological densities may be compared; and further, to point out a few proved pathological causes of certain abnormal densities.

It is easy to write an article claiming certain abnormal densities to be due to a given pathology which we have deduced from our text books. It is a vastly different matter to definitely localize an abnormal density, cut blocks from this carefully localized area, section the blocks and ascertain exactly what cellular pathology caused that abnormal density. This is the method I have pursued and by it Dr. C. H. Bunting of the University of Wisconsin and I did a special research with twenty-six lungs last summer. A complete report of that work will appear later.

The particular need for this article at this time is the war. It has become necessary for the Surgeon General's Office to standardize medical procedure in many departments. Examination of the chest is an important department and the X-ray examination of the chest I consider an important laboratory aid to this department.

It has been discovered that there is a difference of opinion among various roentgenologists and tuberculosis experts as to how this work should be standardized, what technique should be used and how the plates should be read.

One of the officers in our army has made the statement that, "Dunham should not be so fussy. There are many ways of making chest exposures." This is true provided that a definite norm has been accurately described for each of these many ways. I am fussy when in the compilation of many methods I find the compiler asking you to use one man's technique with another man's norm. This can lead to nothing but chaos and failure. If such evident misconception can arise in the army there must be a need for the restatement of these truths for the benefit of clinicians in civil life. Therefore, I present this matter in the form of a manual, or simple directions for the roentgenological examination of the chest. We first outline the

FLUOROSCOPIC METHOD

It is essential that the operator should previously stay in the dark until his eyes are rested and the pupils dilated, so that he may utilize a soft ray which will just penetrate the thorax. A bright light from a harder ray should only be used at the end of the examination to judge the density of any abnormal shadows.

Three fields are to be examined; that to the right and that to the left of the heart, which are observed both in the antero-posterior and the postero-anterior position. The third field is that between the heart and the spine frequently called the median strip. It contains the trachea and the oesophagus and is best examined with the rays passing from the left back to the right front, but any oblique angle may be used. It is of great value to be able to have the screen and tube move together.

Normally the bright fields on either side of the heart should be of approximately the same density, except at the lung roots where the hilum shadow is heavy and from which short trunks extend into the various lobes. Reeder finds the apices normally darker than the rest

of the lung. More of the trunks extending to the lower lobes can be seen on the right side than on the left, because the main stem bronchus on the left side to some extent lies behind the heart. Frequently in healthy individuals dark shadows due to calcification are seen within or near the hilum, and sometimes in the lung fields.

The extent of the excursion of the diaphragm should always be noted. On forced breathing it should be a little greater on the left side than on the right. Anything under 5 cm. on either side should be considered abnormal. The excursion should be greatest in tall, slender people. Irregularities of the dome of the diaphragm should be noted and if possible accounted for. Diaphragmatic adhesions can best be studied by this method and advantage should be taken of our ability to study them from various angles. Sagittal exposures are useful in pleurisy. P. Krause has recommended examining chests with the screen held 4 or 5 inches from the patient. This is a useful procedure.

With the normal lung fields clear in mind, it is easy to detect abnormal increased densities which may be caused by pleural effusion, abscess (whether in the lung field or pushing up from below the diaphragm), diaphragmatic hernia, abnormal tumor masses, pneumonia, thoracic malformations, and tuberculous infiltrations if sufficiently advanced. On the other hand emphysema, pneumothorax, and hydro-pneumothorax, as well as a cavity, appear as lesser densities than normal. Emphysema differs from the normal lung in that the lightness of the lung fields does not change between inspiration and expiration. The diaphragmatic excursion is limited while the chest wall is seen to heave. The right and left domes of the diaphragm are approximately at the same level and flattened. The phreno-costal angle becomes more obtuse and at times is almost a right angle. The dropped heart is usual.

The usual line above a pleural effusion is concave, but pleural effusion may be so encapsulated that it is held in abnormal positions, even perpendicularly along the chest wall. The line above hydro-pneumothorax, when the patient is in the upright position, is always horizontal. The bright area of decreased density above may be somewhat obscured if the lung is collapsed toward the anterior or the posterior wall rather than toward the spine. Thus the value of observing the patient from various angles is apparent. The line above a pleural effusion associated with lung tumor is usually convex. Upon change of position the line above hydro-pneumothorax moves freely; that above pleural exudate does not move, while that above pleural effusion associated with lung tumor and transudates moves slowly.

Pulmonary tuberculosis demands our closest study because it is so prevalent and may exist without symptoms or physical signs. In advanced cases the infiltration encroaches so much upon the air cells that abnormal densities are easily detected, but slight and acute lesions must be searched for most carefully. In such cases a stereoscopic examination is necessary. If the areas above the clavicle do not perceptibly light up after cough a lesion of increased density should be diagnosed and tuberculosis should be suspected. Likewise pericardial and diaphragmatic adhesions as well as pleural effusion should cause the examiner to suspect pulmonary tuberculosis. The diagnosis of tuberculosis in an adult should never be made from abnormally heavy hilum and trunk shadows alone.

The localization of foreign bodies is the same in the lung as in other parts of the body and has been dealt with elsewhere, but it is important to realize that they may easily be overlooked if imbedded in the mediastinum, the spinal column, or in the lower border of the lung, especially on the right side where they are obscured by the liver and diaphragm. It is, therefore, necessary to pass the principal rays at such an angle as to ferret out abnormal densities in these areas.

The examination of the third bright area, the median strip, that between the heart and the spine, should be accomplished with great care. On inspiration there should appear a bright triangle between the heart, the spine and the diaphragm. When this does not appear it is the result of some abnormal density, which must be determined. In the upper part of this central field we have another bright area which lies between the spine and the aorta. Again, when this is not found, the cause must be ascertained. Between this upper and lower bright area the illuminated field narrows and there is such great normal variation of its size in various individuals that it is unnecessary to pay much attention to it unless the bright area is entirely obliterated.

Rupture of the intestinal tract causes free gases within the peritoneum. Below the diaphragm gas anywhere in the intestinal tract stands out as brilliant bright areas normally confined within the intestinal tract. It is necessary for the operator to familiarize himself with the normal locations of these gas pockets, because gas quickly diffuses itself through the peritoneal cavity after rupture of the stomach or gut. In such case the gas is generally seen between the liver and the diaphragm on the right side, while on the left side it appears only as an abnormal area of gas.

The reading of the single plate is practically that of the fluoroscope, with the advantage of providing a record and greater detail.

STEREOSCOPIC EXAMINATIONS OF THE CHEST

The stereoroentgenogram is essential to the complete roentgen examination of the chest. Three factors are essential:

(a) Perfected apparatus.

(b) Mathematical precision of technique.

(c) Binocular vision.

We will not discuss here (a) and (c) but carefully consider (b), and outline that technique that I have determined upon as producing the best record of both normal and abnormal chest densities.

Exposures. The reading of stereoscopic chest plates is the same as that of any other stereoscopic plate, but their taking is different, in that here the *time* is the first all-important factor. The shortest possible exposure, giving good detail is the best. Six seconds is the maximum time allowed from the beginning of the first to the ending of the second exposure. This is necessary because longer exposures produce a fuzzing of the linear marking which simulates early tuberculosis. The lung is of gelatinous consistency, supported in the thoracic cavity by a slight negative pressure of the intra-pleural space and each heart beat causes the lung tissue to quiver.

To secure the necessary speed a comparatively hard tube is necessary, 70 k.v. or a $6\frac{1}{2}$-inch spark gap is the necessary potential. If 50 m.a. of current are passed through such a tube and the plate and tube changing devices are properly working, stereoscopic plates of most chests can be taken in less than four seconds. Such an exposure sacrifices much of the brilliancy of the plate, but gives linear markings which are the subject of our study rather than the bones, hilum and trunks. Do not allow breathing between exposures. Should the patient be very short of breath administer oxygen. Exposures should be made with lungs moderately well filled.

Position of patient. The sitting position is the position of choice. The patient may stand if perfect immobility can be maintained. Under adverse circumstances the patient must sometimes be allowed to lie upon the table. This is never advisable as the heart is enlarged and hydro-pneumothorax is often then overlooked.

The plate should be in front of the patient. This also is impossible at times. When the plate is to the patient's back it must be remembered

that the norm is changed. The chin should be raised and turned to the left. The right cheek should be over the plate. This allows the neck shadows to cover the plate just to the left of the spine within the circle of the first rib. The lung here is farther away from the trachea and less vital tissue is obscured.

In young and supple persons the chin may be forcibly extended, but where this keeps the upper part of the thorax from touching the plate the chin must be turned to the left. This avoids secondary fogging. The plate should be sufficiently high to secure the trachea from the larynx down. Valuable data may then be obtained and you are sure to have a full picture of the apices. Arms should drop with hands in the lap, elbows turned out. This throws the scapula to either side of the thorax. The patient should be held firmly to the plate.

Relation of tube and plate to patient. The target must be 25 inches or more from the plate. The tube must move through a plane parallel to the plate.

The principal ray of one exposure should pass through the spine at the fifth dorsal vertebra a little below the spine of the scapula; the second exposure should pass through the spine 6 or 7 cm. below this. The lower exposure on the average chest will now pass through the spine at the level of the angles of the scapulae and reach the center of a 14 by 17 plate if the plate has been exposed with its 14 inches perpendicular. I consider this advisable. Either exposure may be made first, but it is better to shift the tube parallel to the spine. Thus you see above and below the ribs.

As I said before, this technique is not the only way to make a chest exposure, but it is the technique by which the norm described here was determined.

The reading of stereoroentgenograms consists of an objective description and a subjective deduction. Describe

(1) *Plates*, or the work of the roentgenographer.

(2) *Bones*. Particularly the position of the spine, the corresponding width of the interspaces and the angles of the ribs to the spine, calcification of the cartilages, and all bone lesions.

(3) *Muscles*. Note height and shape of dome of diaphragm, position of heart and aortic arch, pectoral muscles if seen and the breasts of a female.

(4) *Trachea*. Note its position in the mediastinum and relation to dorsal vertebrae and, in front of what vertebra it bifurcates, and where

each bronchus enters hilum shadows. The most important landmark on an X-ray plate is where the left bronchus passes under the arch of the aorta.

(5) *Hilum.* Note how right and left hilum shadows differ from each other and from normal as to size and density and the character of any calcified areas within them. Especial care must be made to detect and locate all trunks which pass from the hilum toward the periphery.

(6) *Right thorax.* This can be divided into upper, middle and lower divisions.

(a) *Upper division.* Three trunks can be made out going to the upper division. Before describing these trunks and linear markings further it is wise to state that the density of each trunk is made up of more than one anatomical structure (bronchus, artery, vein, lymphatic, and connective tissue). Each trunk has an anterior and a posterior division.

The linear markings are fine lines extending from the ends of the trunks like the ribs of a fan toward the pleura. The artery and bronchus remain together to the finest division of the air passage; but there the veins to the septa, marking out the secondary lobules, are as far from the artery and bronchus as is anatomically possible. Thickening of the connective tissue of the septa and veins will cause an interweaving. This is applicable to all trunks throughout the thorax.

The first trunk is called the vertebral trunk. It passes upward more or less parallel to the vertebral column. It usually divides behind the clavicle into radiating lines (linear markings), which normally should not reach the periphery. The linear markings of the vertebral trunks are usually circumscribed by the circle of the first rib.

The second trunk has been named the first interspace trunk, because it lies behind the first interspace and its linear markings extend out behind the first and second ribs.

The third trunk in the upper division is the second interspace trunk, which passes out from the hilum behind the second interspace and sends branches (linear markings) up to the second interspace and down behind the third interspace. This is the largest trunk in the upper lobe.

(b) *Middle division.* The trunk of this division comes off of the main stem bronchus which goes to the lower lobe. This trunk is not always seen in the normal chest. When seen it leaves the main stem bronchus a considerable distance below the second interspace trunk of

the upper lobe. The space between these trunks is greater on the right than on the left side. On the right side the pulmonary artery passes below the eparterial bronchus, which is the union of the upper lobe trunks of the right side. On the left side the pulmonary artery passes above the bronchus, and this is why it is called the hyparterial bronchus. It is the union of the upper lobe trunks of the left side.

A short distance from the main stem bronchus the mid-lobe bronchus divides into a posterior and an anterior branch.

(c) *Lower or posterior division.* Many trunks are given off from the main stem bronchus to this division. Most of them run posteriorly or laterally, except a few which pass in front of the diaphragm and never approach the chest wall above the fifth interspace. These trunks are so matted together and so inconstant upon our plates, that it is impossible to describe them individually. But one important trunk is frequently made out, that going to the apex (upper third) of the lower lobe and it is called the apical trunk of the lower lobe. This passes posteriorly from the main stem bronchus, apparently on a level or a little above the middle division bronchus. It has one branch which passes directly backward and upward from the hilum and is seen in front of the sixth interspace and the seventh rib in the back. A more lateral branch passes slightly downward and is seen on either side of the mid-scapular line in front of the seventh rib and the eighth interspace.

(7) *Left thorax.* The left thorax has only two divisions. In place of the mid-lobe trunks we have the long lingual tip trunk given off from the upper lobe bronchus which passes to the anterior part of the chest and is usually made out in diseases of the heart. It is to be remembered that abnormal lobation frequently occurs.

(a) The trunks to the upper left division are similar to those on the right side except that the vertebral trunk passes to the apex from a point farther within the thorax. It is more likely to be curved and less likely to be parallel to the spine than the right vertebral trunk.

(b) The trunks to the lower lobe are similar to those on the right side except that the basal trunks near the spine are apt to be obscured by the heart.

(8) Note any abnormalities or other findings which vary from a normal plate.

Let us now examine a normal plate by this outline. A normal chest plate shows the ribs bounding the lungs on all sides except below, where we have the diaphragm. The picture is divided into right and left

halves by spinal column and mediastinal tissues. The heart and aorta are quite prominent. The trachea passes down the median line and gradually crosses to the right side of the spinal density. Bifurcation occurs usually in front of the fifth dorsal vertebra, but is higher in children and lower in old people. The left bronchus after passing under the arch of aorta and the right pulmonary artery reaches the hilum nearly in front of the seventh rib and the right bronchus in front of the sixth interspace. By close study of favorable plates these bronchi can be followed into the right and left hilum. The trachea and bronchi are noted as areas of lesser density bordered by lines of greater density. Thus when the rays pass for any length through the lumen of a bronchus we have a brilliant dark area of decreased density (a bronchus on end). Such areas are frequently seen just outside the hilum.

Hilum. This is an irregular area of greater density and frequently contains brilliant spots indicating calcification even in healthy individuals. The trunks pass from the hilum density into the lung fields. The older the person the larger and more dense the hilum shadow. Thus we have the hilum, heavy trunks, and linear markings, all of which are of greater density than is the parenchyma of the lung. When the above points have been described we find that normally the spine should be straight, the ribs regular, the corresponding interspaces of equal width, and the bones free from lesions. Roentgenologically we speak of right and left diaphragm. The right should be higher than the left, with both domes well rounded and smooth. Each reaches the ribs in the axillary line at a sharp angle.

Normal variations are difficult to describe because the norm varies with age. Besides, I have included with the normal many changes which are probably the result of past disease, but which have no clinical significance at the time of examination. Plates of normal individuals taken with the present technique show linear markings radiating more or less definitely from the trunks, but not extending to the periphery.

Necessarily any study of the chest must deal largely with tuberculosis. If we are able to differentiate the normal and the tuberculous from other chest conditions, differential diagnosis in a given number of cases is comparatively easy.

The characteristic tuberculosis plate marking consists of a fan-shaped density with the base of the triangle toward and near the pleura, the apex toward the hilum and connected to the hilum with a heavy trunk. If we have two or more such areas of differing densities we

have a picture pathognomonic of tuberculosis, since tuberculosis is a disease of successive infections. The greatest density indicates the oldest lesion. The pathological lesion within the lung which causes this fan-shaped density on the plate is a cone with its base to the pleura and its apex toward the hilum. The density within this fan-like area varies greatly. The radiating linear markings may either be interwoven, broadened, studded, obscured by a filmy cloud effect, mottled, matted together or entirely blotted out. Striking characteristics of the tuberculous picture are the varying degree of change in the different trunk groups, in contrast to the general homogeneous change in diseases which might simulate tuberculosis, and the lack of continuity with which the trunks may be involved. Thus we may have only the vertebral and second interspace trunks of an upper lobe involved, leaving the first interspace trunk clear. Further it is very striking to note the constancy with which early or slight lesions in the adult are limited to the trunks of the upper lobes.

If the fine linear markings of a given trunk are fuzzy or are faintly obscured by a cloud effect and the fan appears to be wide open, active tuberculosis is suggested. On the other hand if the linear markings in a limited area are sharply defined and dense, and show clean cut studdings beyond the trunks and the fan is partially closed, a healed lesion is suggested. This condition is emphasized if it is accompanied with heavy coarse interweavings which reach to or near the periphery. The heavy trunks between such areas and the hilum are usually broad and dense.

Miliary tuberculosis produces a very striking picture. The lung fields are studded with fine dots of increased density which may be discreet or confluent. The density of these areas varies from the faintest cloud to brilliant spots produced only by calcification. This differs from the common form of tuberculosis in the fact that its roentgen plate strongly suggests, but does not definitely diagnose, tuberculosis. Anthracosis simulates the calcified variety of miliary tuberculosis. It has the same distribution of studdings but each density is more stellate, larger, sharper and thicker. Carcinoma sometimes simulates the uncalcified tubercle. When the age, history and symptoms are considered in conjunction with the plate there is usually little doubt as to the diagnosis.

Caseous bronchopneumonia produces a definite, heavy, flocculent density. It is not usually seen in the apices but in the more dependent

parts of the lung. Its position and appearance suggest that it is the result of aspiration. The fan may or may not be in evidence. If a small lesion near the pleura is involved this will be walled off by heavy septa and the flocculent densities will appear just beyond a trunk of increased density. Then it will have the triangular shape of the fan but the sticks of the fan will not be in evidence. When there is a large lesion it is often impossible to make out from the plates the individual triangles. When such a condition exists at the base there is usually evidence of an old lesion at the apices and frequently there is a cavity.

The operator having familiarized himself with the normal chest markings and having learned to differentiate them from tuberculosis, is able easily to recognize other abnormal densities. The differential diagnosis may be difficult, but the positive recognition of a lesion (an abnormal density) is easy.

Thus we can say that we have a *lung tumor*, but the pathology of that tumor is a separate study beyond the scope of this work.

The diagnosis of *abscess*, *gangrene*, and *cyst* comes under the same category.

No diagnosis of *early tuberculosis* should be made from the X-ray plate without ascertaining whether or not a heart lesion exists.

Brown induration, which is a pathological condition accompanying *mitral stenosis* and *other heart lesions causing passive congestion*, frequently simulates tuberculosis. The density is usually more diffuse and the trunk to the lingual tip is abnormally prominent and zig-zag. *Bronchiectasis* also is a study of itself and while the diagnosis is difficult to make, it is easy to determine that a lesion exists.

The differential diagnosis petween *pneumonia* and *infarct* is almost impossible to make from the plates alone, but the symptoms and physical signs quickly determine the diagnosis. The density of these lesions is homogeneous and the denseness depends upon the extent of lung involvement.

Simple *catarral conditions of the bronchi*, such as *grippe* and *bronchitis*, produce no abnormal densities unless the exudate extends to the air cells, then we have a localized pneumonia.

The plate findings of *pleural effusion*, *emphysema*, and *pneumothorax* are similar to those described under fluoroscopic examination.

Syphilis of the lung, except the old tertiary stellate scar, gives no recognizable X-ray picture.

The finding of *foreign bodies* in the chest is similar to such a procedure for other parts of the body. Having located a foreign body in the chest careful search should be made to see if a pneumothorax or a haemo-pneumothorax exists. It is well to remember that blood in the pleural cavity does not coagulate.

Some of the grosser pathological densities have been referred to under fluoroscopic examinations. I now wish in review to call attention to the varying densities of some lesions which could only be proved by microscopic sections. I mention them in order of lessening density; calcification being the most dense of all pulmonary lesions, caseation following second, with fibrosis a close third. Calcification and fibrosis are closely associated and microscopic flakes of calcification are frequent within the caseation. Such a lesion produces a density which blots out all lung structure. Infiltration by tubercle or carcinoma is less dense: to be intelligently studied its distribution must be carefully noted. Exudates must be divided into cellular and serous, because the cellular exudates are much denser than the serous exudates, but not so dense as infiltration. Hemorrhage, oedema, passive congestion, lobar pneumonia and infarct are difficult and often impossible to differentiate. Their appearance varies with the amount of lung involved. Their plate densities vary from a faint cloud, to flaking, to a heavy snow storm effect, and may appear as a heavy impenetrable mass. The borders of an infarct are often so sharply defined by the septa that its character is suggested. Usually the differential diagnosis rests between infarct and some form of pneumonia because blood has approximately the same density as cellular exudate. An old infarct is largely fibrosed but is not so dense as a tuberculous fibrosis, because the latter is usually associated with caseation. The X-ray plate should clearly define the location of such a density. Then by careful physical examination and a study of the symptoms, which are quite different, the diagnosis is usually completed. A history of hemoptysis is usual with infarct.

This concludes the manual for the roentgenological examination of the chest. Having considered the use of the fluoroscope, the single plate and the stereoscopic plates, I wish to emphasize the value of the last mentioned method. By its use the reading of plates has been so standardized that readings of the same plate made at great intervals or by different men become identical.

STANDARDS OF DIAGNOSIS AND TREATMENT OF TUBERCULOUS CERVICAL ADENITIS[1]

FOREWORD TO THIRD EDITION

In the diagnosis of tuberculosis the greatest difficulties are met in childhood and in the adult non-bacillary cases. In an effort to simplify and standardize these diagnostic problems, the President of the National Tuberculosis Association appointed two diagnostic standards committees. These committees, working in coöperation with the representatives of the Community Health and Tuberculosis Demonstration in Framingham, have prepared the standards suggested in this pamphlet.

It is recognized that diagnostic standards can never be completely satisfactory, for almost inevitably they are either antagonistically dogmatic or qualified to the point of futility. Consequently, these standards are presented with some trepidation, and aim merely to assist the physician to an appreciation of obscure tuberculous lesions.

These diagnostic suggestions have been approved by the National Committee in charge of the Framingham work, and are submitted to the physicians of Framingham and elsewhere for a practical test. The diagnostic standards committees not only attempt to meet the needs in the special fields of diagnosis, but have also made an effort to clarify somewhat the standards for treatment and for classification, employing, in reference to the latter problem, the National Tuberculosis Association classification, with modifications suggested by Dr. W. L. Rathbun, formerly of the Otisville Sanatorium, New York.

It is found that the somewhat novel arrangement of these recommendations into first, definitions, and second, minimum standards, proves practical and helpful. Uniformity as regards standards is, of course, essential to the scientific aspects of the Community Health and Tuberculosis Demonstration, if the results throughout a period of several years are to be at all comparable.

[1] As issued by the Community Health and Tuberculosis Demonstration of the National Tuberculosis Association, Framingham, Massachusetts, in a pamphlet, "Standards for the Diagnosis, Classification and Treatment of Pulmonary and Glandular Tuberculosis in Children and Adults," Third Edition, September, 1918.

The third edition of Diagnostic Standards presents for the first time the conclusions of the special committee on tuberculous cervical adenitis. Except for minor rearrangements the publication is otherwise similar to previous editions, which have been circulated widely among physicians in Massachusetts and other New England states, New York, Ohio, Illinois, Iowa, Texas, and many other communities.

COMMITTEES OF THE COMMUNITY HEALTH AND TUBERCULOSIS DEMONSTRATION

National Committee. Dr. Edward R. Baldwin, *Chairman;* Dr. Charles J. Hatfield, *Secretary;* Dr. Lee K. Frankel, Dr. David R. Lyman, Mr. Homer Folks, Dr. Arthur K. Stone, Dr. Eugene R. Kelley, Dr. Stephen J. Maher, Dr. William Chas. White, Dr. Victor Safford, Dr. F. C. Smith, Mr. Theo. F. Rice, Dr. Enos H. Bigelow, Mr. Henry S. Dennison.

Diagnostic Standards Committee: Pulmonary Tuberculosis. Dr. Arthur K. Stone, *Chairman;* Dr. Edwin A. Locke, Dr. Cleveland Floyd, Dr. John B. Hawes, 2d, Dr. Elliott Washburn, Dr. Vincent Y. Bowditch, Dr. Eugene R. Kelley, Dr. Herbert C. Clapp, Dr. Roger I. Lee, Dr. Richard Smith.

Diagnostic Standards Committee: Tuberculous Cervical Adenitis. Dr. Arthur K. Stone, *Chairman;* Dr. Frank B. Mallory, Dr. Fritz B. Talbot, Dr. R. A. Coffin, Dr. Channing Simmons, Dr. John B. Hawes, 2d, Dr. Allen K. Krause, Dr. L. M. S. Miner, Dr. Charles R. Turner.

Community Health Station Staff. Donald B. Armstrong, M.D., *Executive Officer;* P. Challis Bartlett, M.D., *Chief Medical Examiner.*

THE DIAGNOSIS OF TUBERCULOUS CERVICAL ADENITIS

1. Enlargement of the cervical glands. From the clinical point of view cervical glands should not be considered pathologically enlarged unless they can be easily seen or felt. The small node-like enlargements without symptoms frequently found in children, which remain for varying periods, should not be so considered. Glands of larger size should receive serious attention. Enlarged cervical glands in children under two years of age are usually due to some acute inflammatory process rather than to tuberculosis.

Any well marked enlargement of the anterior cervical glands that persists for several months after throat and mouth infections have been relieved should be considered tuberculous.

2. Exposure. When the cervical glands are found to be enlarged, according to the above standards, in children or adults in whom there has been known exposure to tuberculosis from human or bovine sources, tuberculosis as a cause of such enlargement should be seriously considered. Such exposure as this, however, does not constitute absolute proof that the glands are tuberculous.

3. Other causes of enlarged cervical glands. Enlargement of the cervical glands may take place following or during the acute infectious disease of childhood, and also following acute and chronic tonsil infections, pharyngitis, carious teeth, leukemia, Hodgkin's disease, syphilis, middle ear diseases, eczema, mycosis, or irritation of the ear and scalp, etc. Enlarged glands posterior to the sternocleidomastoid muscle are usually non-tuberculous, especially in children.

4. Constitutional signs and symptoms when the cervical glands are enlarged. When the cervical glands are enlarged as defined above, and particularly when the patient is obviously below par in strength, endurance, and size and is suffering from certain constitutional signs and symptoms, such as anaemia, malnutrition, fever, rapid pulse, loss of weight and strength, as defined in the preceding pages, tuberculosis should be seriously considered as a possible cause of enlargement of such glands.

5. Duration of enlarged glands. As a general rule, tuberculosis should not be considered to be the cause of cervical gland enlargement unless the enlargement persists for several months. It is a safe rule in children to consider any gland tuberculous that has been enlarged for three months or more following the elimination of other obviously possible causes, such as diseased tonsils, carious teeth, etc. Under these circumstances it is wise to treat the gland as tuberculous.

6. The relation of diseased tonsils and carious teeth to enlarged cervical glands. In any case of enlarged cervical glands, diseased tonsils or adenoids should be removed, and carious teeth treated or removed While tuberculosis as a cause of the enlargement of such glands cannot be ruled out, even in the presence of evident focal infection as diseased tonsils or adenoids and carious teeth, it is better to take it for granted that such glands are not tuberculous until the effect of the removal of tonsils and adenoids and cleaning up the teeth has been observed. If, in spite of the removal of such foci of infection, the glands still remain enlarged, it is fairly conclusive evidence that the enlargement is due to tuberculosis.

7. Pathological examination. In a case where there is any doubt as to the diagnosis it is better, particularly in adults, to remove a gland and submit it to a pathological examination to determine the exact nature of the enlargement. Tonsils and adenoids that have been removed should be examined for tuberculosis histologically and by animal inoculation. If these are found to be tuberculous it is wise to conclude that the enlarged glands are likewise tuberculous.

8. Confirmatory evidence. Confirmatory evidence may be secured through the tuberculin skin test and the X-ray and is, of course, to be found in manifest tuberculous conditions in other parts of the body.

THE TREATMENT OF TUBERCULOUS CERVICAL ADENITIS

1. Tuberculous cervical adenitis should always be treated as a general disease with local manifestations.

2. All possible portals of entry of infection, such as teeth, nasopharynx, tonsils, infections of the ear and scalp, etc., should be examined and treated.

3. There is no short road in the treatment of cervical adenitis. All of the methods of treatment should be carefully considered, in each individual case and whatever line of treatment is instituted, hygiene should play a most important part.

4. Tuberculin, surgery, heliotherapy, and X-ray may be valuable in the treatment of tuberculous cervical adenitis when associated with hygienic treatment. No one method of treatment should be used to the exclusion of others. Do not treat the "lumps in the neck," but treat each individual case as it presents itself, using any or all of the above methods to accomplish the desired results.

MEDICAL NOTES, ABSTRACTS AND REVIEWS

It will be the eventual purpose of the REVIEW thoroughly to canvass all literature on tuberculosis as it appears in other medical periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the Abstract Editor, Dr. George Mannheimer, 41 West 51st Street, New York, N. Y.

Coördination of X-ray and Blood Findings.—A coördinated study of the x-ray findings, the complement fixation reaction, the total number of white cells, the percentage of lymphocytes, and the Arneth index will lead to a correct estimation of the pathology of a given tuberculous process, will help to differentiate tuberculosis from other conditions simulating it, and will establish the prognosis in a given case of tuberculosis. The x-ray does not indicate alone whether a certain case is active or inactive. The complement fixation test in an active case may be negative, when it indicates that the blood is deficient in antibodies. The number of leucocytes shows the fight the blood is making to overcome the disease. The lymphocytes are the cells specially trained to fight the tubercle bacillus, and the Arneth index shows the reserve cells of leucocytes reaching a mature stage. A biologic study of the white cells has shown that the neutrophile polynuclear originally has a single nucleus and as it ages this nucleus breaks up into multiple nuclei, so that the number of nuclei roughly shows the age of the neutrophile. Adding together the number of cells having one nucleus, two nuclei, and half of those with three nuclei we obtain in a count of one hundred cells the Arneth index. In normal persons this figure is between 50 and 60. That is, the remaining number of cells out of 100 have reached maturity. The more cells reach maturity the better the fighting chances of the patient; therefore, the prognosis is better the lower the Arneth index. The patient's general resources against destructive processes is to be gauged by the Arneth index while his specific fighting power against the tubercle bacillus is to be estimated by the lymphocyte percentage. The latter are the fighting army, the Arneth index shows the reserve resources. A lymphocyte percentage above 30 shows that there is a sufficient fighting army; an index below 50 means rich resources behind that army. The resistance index of the patient can be studied by a coördination of these findings if a definite percentage is assigned to each finding, taking the normal as 100 per cent. Thus, representing the normal x-ray findings of the chest as 100, slight inactive involvement as 80 per cent, moderate inactive involvement as 70 per cent, slight active involvement as 60 per cent, etc., and adding together the percentages similarly obtained by listing of the lymphocyte percentage, Arneth index, and complement fixation we obtain a figure which, divided by 4 (the number of items considered), gives the resistance index. For instance a patient has moderately advanced, active pulmonary tuberculosis as shown by x-ray and physical findings. Such case is assigned a percentage of 40 in the list. The same patient's lymphocyte percentage is 22 which is 35 per cent of the normal 40 per cent. The Arneth index of the same patient is 63 and this represents 85 per cent of the normal 55 (which represents 100 per cent). The complement fixation test is negative; when this is the case in the presence of an active process the prognosis is poor, 25 per cent being the figure assigned. Adding together 40, 35, 85, and 25 we obtain 185 which divided by 4 gives the resistance index of 45 per cent. By watching the patient in the course of his illness and by subsequent blood examinations we can follow the resistance index and see whether it improves. A table of fifty patients whose findings were thus studied is appended proving that by this method a fairly reliable immediate prognosis can be obtained.—*The Pathological Significance of Roentgenological and Hematological Findings in Tuberculosis. W. W. Watkins, Southwest. Med., April, 1918, ii, No. 4, 20.*

Physical Signs and the Roentgen Plate.—The physical signs should always be compared with shadows seen on the plate. It is assumed that in a broad sense the same physical laws which govern the transmission of sound also govern the transmission of light. Thus, in the case of a thin bronchus through which the passage of air during inspiration produces a cer-

tain murmur upon the chest wall the number of vibrations is the same per minute as in that of another bronchus which is rigid or dense. In the latter, however, the vibrations are transmitted through a narrowed tube, a greater number are transmitted through the wall and while the number of vibrations in the two bronchi is the same, they are produced by different causes. The lines on the plate in the case with the thin bronchus, similarly, will be thin and far apart; while in the second case they will be dense with only small air content. It is possible in most cases to predict the x-ray findings from the physical examination. The shadow on the roentgen plate is only a physical sign.—*Relation of the Physical Signs to the Roentgen Plate in Pulmonary Tuberculosis. J. J. Singer, Am. J. M. Sc., July, 1918; clvi, No. 1, 68.*

Clinical and Roentgen Findings.—In view of the difficulty of interpreting physical signs in the chests of infants and little children, a study of the comparative results of roentgenograms was made for this purpose. In the growing child the heart is frequently in conditions that embarrass the diagnosis. The muscle is soft and liable to dilatation in disease or even from over exertion, and there is a variety of adventitious sounds not easy to interpret. A study of the shadow of the heart may help to decide whether murmurs are hemic, muscular or valvular. It is often hard to interpret the heart shadow of little children owing to the difficulty of keeping them quiet, and before reaching conclusions one must study the anatomic points to be sure that the chest is kept straight during exposure. Comparison between physical signs and roentgenograms in 15 cardiac cases showed practical agreement in 7, partial agreement in 1 and non-correspondence in the other 7. As regards the lung findings, a combined study of the two methods of examination was made in 97 cases, and showed substantial agreement in 77, and disagreement in 20 of the cases. As examples of the latter, 5 gave roentgen. ographic evidence of lobar pneumonias that were detected by the physical signs, 2 gave physical signs of lobar pneumonia not shown in the shadow picture. Three showed physical signs of broncho-pneumonia not exhibited by the roentgen ray. and 2 failed to show the presence of fluid in the pleural cavity by physical signs when it was shown by the roentgen ray. As a general rule it was found that the roentgen ray often revealed, in the absence of physical signs, congestion, small consolidations, hilum infiltrations interlobular pleurisy, miliary tuberculosis, and mediastinal tumors. It may, therefore, be helpful in these conditions, especially in hilum infiltrations and enlarged nodes in the mediastinum. The comparison here made showed that the transmission of voice sounds below the seventh cervical vertebra (d'Espine's sign) has considerable value in diseased conditions at the root of the lung. Brief reports of a number of cases illustrating the points made in the paper are given, and there are eleven illustrations.—*Comparison Between Clinical and Roentgen Findings in Diseases of the Chest, H. D. Chapin, J. Am. M. Ass., May 11, 1918, lxx, No. 19, 1357.*

Reduction in Transparency of Normal Lung.—Lebon expatiates on the misleading findings possible even in the normal lung. The obese and persons with thick muscles are less transparent to the roentgen rays than others; if the apical regions are not fully transparent this need not imply a bilateral lesion. The apices may not dilate evenly on both sides during inspiration, and the right apex is nearly always less transparent than the left apex. Persons who have been long in bed may have an area of dulness over each apex, and the same factors responsible for this may render the apices less transparent. The difference in the size of the bronchi aids in rendering respiration asymmetrical. Hence a slight haze over the right apex, and exceptionally over the left, is not incompatible with the integrity of the lungs. Sometimes the clavicle interferes with roentgenoscopy, and only by having the patient cough can we get a glimpse of the apex as the clavicle is transiently lowered during the cough. Examination from the rear is more instructive. A radiograph of the apex alone, taken in apnea, with brief exposure, usually is decisive; roentgenoscopy alone may not suffice. Even with small lesions, revealed by auscultation, the roentgen findings may be negative. Positive roentgen findings were always accompanied by positive auscultation signs. A haze over both apices, without stethoscopic signs, is by no means a reason for assuming a tuberculous lesion. When one apex alone seems veiled, this is much more suggestive, but even this does not justify the diagnosis of tuberculosis if the stethoscope is negative. Only when the roentgen, auscultation and percussion findings harmonize, can we regard as certain the probabilities of a tuberculous apical lesion.—*Diminution de la transparence normela des Sommets du poumon dans la tuberculose, H. Lebon, Presse Méd., February 14, 1918, xxvi, No. 9, 78.*

Tuberculin in Eye Lesions.—The ophthalmic reaction should never be used in an eye which has a suspected local tuberculous lesion. Violent reactions have followed its use, with permanent loss of vision due to corneal ulceration. The von Pirquet reaction is of very limited value in the differentiation of the etiology of eye lesions. The subcutaneous reaction is of much value when it is accompanied by a focal reaction in the eye. A focal reaction in the eye may be mild but is of sufficient diagnostic value if it consists of an increase in circumcorneal injection or an oedema of the cornea or an extension of the infiltration into deeper layers. There may be an increased cloudiness of the aqueous with more numerous deposits on Descemet's membrane if the lesion is iritis; or, if choroidal or retinal, the lesion shows greater activity in increased cloudiness and oedema of the vitreous and, possibly, fresh hemorrhages if the blood vessels be chiefly affected. The dose of tuberculin depends upon the location and activity of the lesion. In corneal lesions, on account of the deficiency of the blood supply, a larger dose is necessary to cause a reaction. Here 0.1 mgm. can be given with impunity. In acute iritic lesions 0.5 mgm. may be given; while in less active lesions as much as 5 mgm. may be necessary. When the focus is in the choroid or retina much caution should be exercised. No tuberculin should be given if there is an active lesion near the macula; the eye should first be put to rest, and general hygienic measures should be instituted until the lesion becomes subacute or chronic when the smallest dose may be used and increased, if necessary, until a mild focal reaction is produced.—*Upon the Use of Tuberculin in the Diagnosis of Eye Lesions, C. A. Clapp, Arch. Diag., October, 1917, x, No. 4, 399.*

Differential Diagnosis. — Differential diagnostic points are given for the following conditions: Aneurysm of the aortic arch; bronchial asthma; bronchiectasis; chronic bronchitis; bronchopneumonia; chlorosis; chronic pneumonia; diaphragmatic pleurisy; echinococcus cyst of lung; empyema; foreign bodies; gangrene of lung; Hodgkin's disease; hyperthyroidism; actinomyces; aspergillus; streptothrix infections; influenza; intercostal neuralgia; malaria; malignant disease of lung; mitral stenosis; neurasthenia; pleurisy; pneumoconiosis; pulmonary abscess; pulmonary infarct; syphilis; throat affections; typhoid fever; yeast infection; urticaria of respiratory passages.—*Differential Diagnosis in Cases of Suspected Pulmonary Tuberculosis., A. Minrig, N. York, M. J., October 13, 1917, cvi, No. 15, 692.*

Tuberculin.—The tuberculin test probably owes its activity to the presence of a specific protein of the tubercle bacillus, either in solution, as bacillary bodies, or as particles of such. It is undoubtedly closely related to the anaphylactic reaction. The theory of Wassermann and Bruck may serve as a working formula. According to them the reaction of tuberculin depends on a union in the lesion of the injected tuberculin with the antituberculin anchoring large amounts of complement at the site, causing the symptoms observed. If there is no reaction they presume that sufficient antituberculin is present in the serum to unite immediately with the tuberculin injected and prevent this from reaching the tuberculous focus. If the reaction is absent in advanced tuberculosis it is assumed that the cells, owing to long stimulation, can no longer furnish the antibodies. Some observers do not accept this explanation, and hold that the local traumatism at the point of injection may explain it. The comparative efficiency of diagnostic tests is told, of which the cutaneous or von Pirquet test, seems to be the most efficient. Detre's modification of it is described, but Ryan does not believe that Detre's grouping can be accepted, and does not hold when the patient reacts only to the bovine tuberculin. The method of application is described as follows: The arm, preferably the external surface of the upper arm, is cleansed with ethyl alcohol. Through the superficial part of the skin, five abrasions are made, deep enough to remove the skin, but not to draw blood. These abrasions are made with a small instrument similar to a jeweler's screw driver, by lightly boring with it into the skin. The abrasions should be about three-fourths inch apart and range in a longitudinal straight line parallel with the long axis of the humerus. Persons who do not have tuberculosis do not react to tuberculin, but there are conditions in tuberculosis, in which the patient is insensitive to the test, as in extreme toxemia, with no antibodies present. Completely healed lesions will not react. Other acute conditions may mask the tuberculosis, and in very acute tuberculous infections the test may be negative. The Detre test as modified has certain advantages. It is easy in application, and is of some value in prognosis. Its absence in a case of known tuberculosis would be of bad import. Technical errors and constitutional disturbances are very rare.—*Tuberculin as a Diagnostic Test of Tuberculosis in Man. L. M. Ryan, J. Am. M. Ass., April 6, 1918, lxx, No. 14, 982.*

Virulence of Tubercle Bacilli.—Corper has been investigating the problem of the relative virulence of tubercle bacilli in the sputum of consumptives. The earlier literature is indecisive as to this question. Certain considerations must be kept in mind, however. Fraenkel and Baumann found guinea-pigs alone available for determining the pathogenic properties of tubercle bacilli, and Marmorek calls attention to the fact that in this study of the infectious power of the bacilli it is necessary to note the distribution of the anatomic lesions, and only in a very insignificant manner consider the duration of life. Corper, therefore, began his studies with the use of rabbits and guinea-pigs, the former merely to determine the type of bacillus, or whether human or bovine. The purpose was not to determine the smallest number of the germs necessary for causing infection, but to determine the range of virulence of tubercle bacilli isolated from the sputum of open consumptives. It was deemed satisfactory to use the dilution method, after weighing the amounts of bacilli used, and to count the bacilli by staining them after carefully making the various dilutions. This method had the advantage of not exposing them to light. In speaking of virulence, one must remember that this term is merely relative. An organism may be highly virulent for one type of animal and yet be avirulent for another. Thus, for example, the human tubercle bacillus is non-virulent for the rabbit. This means in reasonable doses and within reasonable time. It is also advisable to remember that infection in man is due to repeated or prolonged, rather than a single, exposure, and that death in tuberculosis is due generally to accident. This is especially significant in ruling out duration of life as a factor in determining the virulence of the tubercle bacillus. The tubercle bacilli used in these studies were directly cultivated from the sputum by Petroff's method, and were usually from one to two months old. "No appreciable difference was noted in the virulence of the bacilli taken from the same culture at from one to three months. For the tests, an emulsion was made equivalent to 1 mg. of the moist culture in 1 cc. of physiologic sodium chlorid solution, so that on examination the bacilli were found at most only in lumps of from two to ten. The emulsion was then diluted with physiologic sodium chlorid solution until 1 cc. contained 0.1 mgm., 0.001, 0.000,0001 and 0.000,000.01 mgm. These amounts were then injected into four male guinea-pigs, all of the same size and weighing from 500 to 600 grams. At the end of two months after infection, the guinea-pigs were examined for anatomic involvement and graded from − to++++, depending on the extent of the involvement. The number of bacilli found per milligram of moist culture was from 5 to 6 billions, so that the 0.000,000,01 mgm. dilution contained from fifty to sixty tubercle bacilli." Eighty-two cultures were thus examined, and all but two of these produced tuberculosis in the guinea-pig within two months after a subcutaneous injection of 0.000,001 mgm. of the moist culture. Doses as small as 0.000,001 mgm. could produce tuberculous infection in guinea-pigs, and the range of variation of virulence is very small. These findings point to the dangers of droplet infection, and it seems justifiable to conclude that the tubercle bacilli found in the sputum of consumptive patients varies slightly and are practically all pathogenic, and that a dose as small as 0.000,001 mgm. might infect a child, as may be deduced from Webb and Gilbert's observations. These experiments also seem to lay special emphasis on the importance of sputum examination in military test requirements.—*Are All the Tubercle Bacilli Found in the Sputum Virulent; H. J. Corper, J. Am. M. Ass., May 4, 1918, lxx, No. 18, 1281.*

Enzymes of Tubercle Bacillus.—Evidence of the presence of a connective tissue or elastic tissue disintegrating enzyme in the tubercle bacillus was not obtained, at least by the methods used for this purpose. Tubercle bacilli of both the human and bovine varieties possess autolytic enzymes, as indicated by the non-coagulable nitrogen and amino-acid, a nitrogen liberated at incubator temperature after the bacilli have been killed by toluene and chloroform. The bacilli themselves, or autolysates therefrom, also possess a trypsin-like enzyme capable of splitting proteins in alkaline solution, an erepsin-like enzyme capable of decomposing peptone in acid solution, a weak pepsin-like enzyme capable of splitting proteins in acid solution, a nuclease capable of splitting nucleic acid and a urease capable of decomposing urea. The tubercle bacilli, or autolysates therefrom, do not possess enzymes capable of hydrolyzing starch or inverting sucrose, demonstrable by the delicate Lewis and Benedict picramic acid method. Autolysates from tubercle bacilli do not possess enzymes capable of digesting elastic tissue prepared from lamb lung, or connective tissue prepared from tubercles, at least.—*Enzymes of Tubercle Bacillus. H. J. Corper and H. C. Sweany, J. of Bacteriol., March 1918, iii, No. 2, 129.*

Toxin Extracted from Tubercle Bacilli.—Long research has resulted in the extraction from tubercle bacilli of a toxin which responds to all the tests for peptone. It kills guinea-pigs weighing 500 grams in six days, in a subcutaneous dose of 0.5 cc. If the animals are prepared with small doses, commencing with 0.1 cc. to a total of 1 cc. in fifteen days, they stand subcutaneous injection of the otherwise fatal dose of 0.5 cc. without showing any disturbance. The serum of rabbits prepared in this way confers immunity also on other rabbits. Unprepared rabbits died in two hours after injection of 2 cc.; with a dose of 5 cc. rabbits die in one hour, and with 10 cc. death is practically instantaneous. This peptone toxin from tubercle bacilli promises to be useful in serotherapy as its extreme toxicity and the immunity it confers fulfil the desiderata better than anything else known to date. No details are given as to the technic for extracting this "new peptona toxin," as they call it.—*Toxin Extracted from Tubercle Bacilli, L. Sivori and F. Jauregui, Prensa Med. Argent. November 30, 1917, iv, No. 18, 235.*

Sensitiveness of Tubercle Bacilli to Acids.—The writer has carried out an investigation in order to determine the relative sensitiveness of both human and bovine strains of tubercle bacilli and of other species of acid-fast organisms. Some seven human and four bovine strains of tubercle bacilli were tested. Of these all were found to be killed by twenty-four hours' contact with N/10 acetic, citric, and sulphuric acids, but were not killed within twenty-four hours by N/13 dilutions of the acids. The bacilli were also destroyed by oleic, palmitic, and stearic acids if such acids were in a finely divided state and sufficiently mixed with the bacterial emulsion. No difference in regard to sensitiveness was observed between the human and bovine strains. Five other species of acid-fast bacilli were found to be much more sensitive than the tubercle bacillus to the action of acetic, citric, and sulphuric acids, being killed in twenty-four hours by N/80 dilutions of the acids. These acid-fast organisms however, were very much less sensitive than the tubercle bacillus to the action of oleic, palmitic, and stearic acids.—*The Sensitiveness of Tubercle and other Acid-Fast Bacteria to Acids, Porto, J. of Hyg., xvi, 1917 (from J. of State Med., March, 1918, xxvi, No. 3, 91).*

Strains of Tubercle Bacilli from Animal Tuberculosis.—Griffiths reports the results of experimental work carried on from 1911 to 1916, in which he examined a number of strains of the tubercle bacilli from naturally acquired tuberculosis in animals. Out of 14 strains derived from 10 monkeys, 50 per cent yielded tubercle bacilli of bovine type, this proportion being much higher than that reported by other observers who found in 37 naturally tuberculous monkeys only 3 (8.1 per cent) were infected with bovine tubercle bacilli. That so many naturally tuberculous monkeys should have yielded the bovine type is not surprising when it is remembered that monkeys are as susceptible to bovine as to human tubercle bacilli, and when in captivity are frequently fed on cows' milk. But an interesting fact in the majority of "bovine" cases here reported is that the infection appeared to be of respiratory origin, the intestines and mesenteric glands showing only minor lesions, if any. The other animals examined were one cat, one goat and seven birds. The cat, a domestic pet, was found to be infected with a typically bovine type infection being by way of the alimentary tract. The goat, purchased for experimental purposes, reacted to the tuberculin test and so was killed and examined. A culture obtained from a lung nodule exhibited the characteristics of the bovine type of tubercle bacillus. This is apparently the only case of natural tuberculosis in the goat in which the type of bacillus has been determined. The seven birds examined comprised a lap-wing, a pigeon, a goshawk, an ibis, a quail, a grackle and a pheasant. All the strains exhibited the characteristic cultural features of the avian type of tubercle bacillus. Griffiths included in his report the results of an investigation of the cultural characteristics of a series of strains of bovine tubercle bacilli derived from cows' milk. Twenty-eight strains were examined by him and the findings compared with those of the Royal Commission on Tuberculosis. All possessed the same characteristics, *i.e.*, they varied as to their mode of growth on glycerin media, some being very dysgonic, others relatively eugonic and others displayed intermediate degrees of luxuriance. Another interesting finding incorporated in this report is that of a newly calved heifer, two and one-third years old, vaccinated when four days old with living human tubercle bacilli. Upon examination of the first milk produced a virulent strain of the human type was demonstrated. At autopsy, with the exception of a single minute gray tubercle in the lungs, no sign of tuberculosis was found anywhere in the body. The purpose of this investigation was not so much to show the efficacy of vaccination as to draw

immediate attention to the possible danger of using for human consumption the milk of cows which had been vaccinated with living human tubercle bacilli.—*Investigation of Strains of Tubercle Bacilli from Animal Tuberculosis, Griffiths, J. Path. Bacteriol., July 1917, xxi, 329.*

Bovine Tuberculosis.—Considering the persistent propaganda, both oratorical and literary, waged against tuberculosis, one might be misled into thinking that sufficient had been said and written to have broken down long ago the apathy with which both producers and consumers of cattle and their products regard this eradicable scourge.

That this is not so is, unfortunately, only too evident, and a cordial welcome will be extended to an excellent addition to the cause. This book deals with tuberculosis as it exists among the herds in America. The position in this country is far from being satisfactory. The annual loss to stock-keepers from tuberculosis alone is something like $25,000,000.

Though financial loss is insignificant when compared with the needless sacrifice of young human lives, it must nevertheless play an important part in helping to dispel illusions and to stimulate new endeavor.

That the continued prevalence of this preventable disease is largely due to ignorance is freely admitted, and the significance of education has obviously been in the minds of the contributors to this book. *Bovine Tuberculosis*, therefore, setting out, as it does, to educate those who are responsible for the retention of diseased animals in their herds, those who put into effect such efforts as are being made to control and eradicate it, and, lastly, those who *should* take some interest in the matter but who do not, will unquestionably do good

Russell makes it his business to show how both producer and consumer suffer monetary loss, and, what every stock-owner should realize, how the owner of a tubercle-free herd pays for the indifference of his less enterprising neighbor. While admitting that range-cattle are less prone to infection than are pure bred dairy and beef animals for reasons stated, Russell refutes the belief which some have that they are tubercle-free, and he gives an instance where, in 1910, 1000 range-cattle were tested, with the result that 10 per cent reacted to the test. The introduction bristles with statements and suggestions which one is tempted to quote. The reading of one paragraph fills us with alarm for the possibility of tuberculosis eradication in America:

"The one great trouble at the present time with effective work in this line is that far too many health officials are controlled by politics, and men having this work in charge in a certain city or village this year may, on account of the expiration of a political term, be removed from office and have nothing to do with the work during the year following." Surely not a very hopeful outlook.

Devine deals with tuberculosis, its cause, symptoms, diagnosis, and control and eradication, in a manner intended to place such information before the stock-owner, for whom it is a necessity if he is really to understand the present serious condition and how it could be improved. The thermic tuberculin test is very carefully explained, and as stock-owners frequently fail to realize its use and its limitations, this chapter is of exceptional value. He concludes that "while the subcutaneous test involves more labor and expense than either the ophthalmic or intradermal test, the percentage of accuracy is in its favor."

Unqualified persons who think themselves fit to apply the test may read the following with profit to themselves and others: "We should like to make our position clear at this point in reference to anybody or everybody making a so-called tuberculin test. Making a tuberculin test does not consist simply in a mechanical procedure of taking temperatures and using a hypodermic syringe. It is our judgment that a man who is not trained in the knowledge of the preparation of biologics and the principles of physiology, comparative pathology, and animal diseases is not capable of making a reliable tuberculin test."

No less interesting is the section on the intradermal test by Luckey. It will be greatly appreciated by veterinarians both young and old. This writer favors the intradermal test before either the thermic or ophthalmic—"From the very beginning the intradermal method has produced the most satisfactory results. Apparently this method of testing cattle for tuberculosis has gained favor wherever it has been used."

Those who believe in testing "by the rule" will have their complacency shaken. "The beginner briefly surveys the technic of the tuberculin test and is too prone to consider himself its master. He is likely to begin this work with the utmost confidence that he will draw an infallible line between the diseased and healthy cattle, and that all those which he condemns will show an abundance of lesions. As he proceeds, his over-confidence fades. After a year or so of actual and continual practice he begins to come to himself. At the end of some ten years he may, if he is wise, come to a

rather full realization that the tuberculin test is not only the most sacred work falling into the hands of veterinarians, but that it is the most intricate and complex. There are very, very few artificers administering the tuberculin test. Considering the number of novices who, in the past, have been permitted to apply it, it is wonderful that the tuberculin test has survived." Such opinions expressed by a man who has made over 100,000 tests are surely worth heeding.—*Bovine Tuberculosis, J. F. Devine, D. V. S. With an Introductory Article by E. Z. Russell, a Discussion of the Intradermal Tuberculin Test by D. F. Luckey, D. V. S., and an Article on the State-accredited Herd by O. E. Dyson, D. V. S. Chicago, American Veterinary Publishing Co., 1917, (from Vet. Rev., February, 1918, ii, No. 1.)*

Veterinary Inspection and Protection against Tuberculosis.—The committee framed a series of 38 questions and sent them to the secretaries of all the milk commissions. From the 41 per cent of satisfactory replies they now submit certain recommendations. Tuberculin tests to accomplish the best results should be made semi-annually. It is recommended that the American Association of Medical Milk Commissions should elaborate careful details of the technique of the subcutaneous test and include these in the requirements of the association. The intracutaneous and ophthalmic tests are of value in aiding in the elimination of tuberculosis. The combined tests should be used when indicated by unusual circumstances. All abnormal nonreactors should receive a careful physical examination. The importance of special bacteriological examinations of milk to discover unusual carriers should be recognized. The immediate removal from the herd of all suspicious animals should be ensured by special regulations. The importance of having at each dairy a satisfactory place for complete isolation should be recognized. Non-reactors in a tested herd should not be added to a certified herd if the percentage of reactors in the tested herd has been more than a certain definite percentage—the percentage to be determined later. Tuberculin test records for additions to the herd should only be accepted when made by the official veterinarian of the commission or by a representative of the Department of Animal Industry except under special circumstances and regulations. Under ideal conditions all additions to the herd should be segregated until a second test has been made from sixty to ninety days after the initial test. While the second test may be made by the intracutaneous method, the first test should always be made by the subcutaneous method. Dairymen should be impressed with the importance of protecting young and dry stock from infection in contaminated pastures. Certified dairies should be encouraged and stimulated to raise all heifer calves. The purchase of outside milk for feeding calves should be discouraged, if not prohibited, but if used the milk should be boiled. The dairyman should be impressed with the importance of avoiding contaminated drinking water for cattle. The use of individual drinking cups and troughs is desirable, but it is very questionable if they have reached as yet a degree of perfection that renders them absolutely safe and therefore desirable. It is ideal, though perhaps not practicable, that all reactors or nonreactors from a certified herd should be slaughtered under the supervision of the official veterniarian. Inasmuch as the percentage of reactors in certified herds is occasionally as high as 10 to 40 per cent, it is incumbent to insist on the minutest detail in an effort to combat tuberculosis. Identification cards are of value in keeping accurate records of each animal. The question of stable disinfection has not been satisfactorily solved. If satisfactory resulst are to be obtained concerning the tuberculosis situation in certified herds, concentrated efforts will have to be made by everyone interested in this problem, because it is only by hard work and attention to detail that tuberculosis will ever be controlled.—*Report of the Committee on Veterinary Inspections and Protection against Tuberculosis of the American Association of Medical Milk Commissions, 1916-1917, E. C. Fleischner, J. Am M. Vet. Ass., December, 1917, lii, No. 3, 307 (from Veter. Rev., May, 1918, ii, No. 2, 205).*

New Visions of an Old Plague.—"The problem of eliminating tuberculosis from farm animals in order to prevent losses estimated at $25,000,000 a year in the United States is the greatest problem confronting the livestock industry of the country." (Secretary of Agriculture Housto .)

More than 100,000 persons die in the United States every year from tuberculosis. The percentage of this vast number who acquire the infection in childhood with the milk ingested, is speculative; but, certain is that in the aggregate the number who thus acquire it is large, and to this extent tuberculosis of man is a veterinary problem. It lies with the veterinary profession to recognize and point to the source of this infection and arouse the public to the end that it be eliminated. Day after day, week

after week, and month after month, countless numbers of children are ingesting the germs of tuberculosis with unpasteurized milk, that comes from cows that are being tested throughout their lives for tuberculosis by generation after generation of hogs raised on the same farms. On millions of farms in the United States a conclusive test for tuberculosis is being made every season. Wherever hogs are being raised on the same farm with cattle, feeding on feces and on unpasteurized milk, they incidentally but accurately test the cattle and report unmistakably the existence of cases of open tuberculosis among cattle. Year in and year out, trained veterinary pathologists find 10,000 hogs infected with tuberculosis and ever as these infected animals pass under the inspector's eye, the question arises: Whence? It is well known that tuberculous hogs owe their infection almost exclusively to tuberculous cattle. On certain unknown farms in the United States 4,000,000 hogs are infected by the milk and the feces of tuberculous cattle, an appalling waste of food, but more than all, an appalling waste of human life, for the milk contaminated with feces, as all ordinary market milk is contaminated, that will infect a hog will infect a child. If farmers were required to ear tag their hogs, we could go from the infected hog back to the infected cow and stop the infection of the children and prevent the death of the unknown but certain, and I believe very large percentage of the more than 100,000 persons who die annually of tuberculosis.

Rogers conveys his message in an illustrative diagram and proposes as a remedy the following general plan of a county experiment:

Choose a typical county, preferably in Iowa, Illinois, Indiana or Wisconsin. Deposit in the various banks of this county a sufficient sum to indemnify 10 per cent of the total hog and cattle valuation of this county. Probably no locality has more than 6 per cent of tuberculous animals. The general average in meat inspection is only 2. Estimates have run from 0 per cent to 50 per cent and this would determine that point. Explain it thoroughly to the bankers and get letters for publication from each. Secure a list from all the farmers in this county from the last census. Prepare and mail to them an illustrated pamphlet explaining the plan in detail to them. Guarantee them freedom from financial loss in any way. Induce all those who have both hogs and cattle, to have their hogs associate with their cattle as much as possible for a time with the understanding that the hogs are testing their cattle. Furnish the farmers with tags and tag appliers. Induce them to tag their hogs immediately after they have loaded them into their wagons. If they do not care to go to the trouble have men stationed at the hog shipping stations.

Have as many go to packing houses having inspectors as possible. Get in touch with the local butchers and be present when they slaughter. Trace all tuberculous hogs back to the farm from which they came by means of the ear tags. Conduct the tuberculin test on all the cattle on this farm. Buy up all the reacting tuberculous animals at full market values from the funds deposited in the banks. Sell the animals subject to inspection. Return the proceeds back to the banks. Do this for two years, or until it is felt every farmer has sent in hogs that have associated with and tested his cattle. Most hogs are marketed and slaughtered when less than one year of age. Then conduct the tuberculin test on all the animals on all the farms in this county, to determine how many are still left in this county. Indemnify for all the remaining animals thus found. Publish the results of progress from time to time without referring to any farmer in particular. Finally publish the results, giving all the figures and conclusions. Suggest improvements that the experiment suggests. The state or county which offers favorable inducements, consisting in the main of a universal cooperative spirit, will be greatly benefited, and have the high honor, of being the first populated county in the country known to be absolutely free from tuberculous animals and tuberculous meat and milk, except that brought in. Without doubt the stock of this county would bring a higher price than the stock from any other county, because the packers would run absolutely no risks from tuberculous condemnations.—*New Visions of an Old Plague, B. R. Rogers, Am. J. of Vet. Med., February 1918, xiii, No. 2.*

Intertransmissibility of Tuberculosis.—Pulmonary tuberculosis rarely, if ever, is due to bovine infection, but almost always to infection from man to man through the medium of the dried-out pulverized sputum, or sputum droplets, expelled into the air by coughing. Children fed for considerable periods of time with milk, which contained bovine tubercle bacilli in only a small percentage developed signs and symptoms of glandular or intestinal tuberculosis. However, in certain cases, bovine tuberculosis may be transmitted to man, especially to children, by the ingestion of milk from tuberculous cows. Therefore, mankind must be pro-

tected against this transmission by stamping out tuberculosis in cattle and by preventing the ingestion of milk containing live bovine bacilli. The most important single measure to prevent the spread of pulmonary tuberculosis however is the destruction of tuberculous sputum. In the 100 cases of pulmonary tuberculosis examined by Corper in the Chicago Municipal Sanitarium not one of bovine infection was found.—*The Intertransmissibility of Human and Bovine Tuberculosis, M. Herzog, Monthly Bull. Chicago Munic. Tuberc. Sanit., March 1918, i, No. 3, 11.*

Making Cattle Environs Free From Infection.—Experiments were conducted to determine how long the tubercle bacillus retains its virulence outside the body. It was found that (1) tubercle bacilli in faeces and lung discharges can no longer produce tuberculosis in guinea-pigs by inoculation when exposed in the dry season for three months, depending to a great extent upon how soon the vehicle in which the bacilli are found is freed from moisture, and (2) tubercle bacilli remain alive for at least six months in water.

The value of hypochlorite solutions was tested in the following manner: Tuberculous lung discharges were smeared in a very thin film on small blocks of wood; these were placed, their faces downwards, in deep porcelain dishes, each holding 500 cc. of chlorinated lime solution; they were exposed to the action of the chlorinated lime solution as follows:—One minute in a 3 per cent available chlorin solution; one minute in 2 per cent solution; two minutes in 1 per cent solution; five minutes in 0.75 per cent solution, and five minutes in 0.5 per cent solution. After the exposure for the above-mentioned time, they were allowed to dry in a closet for twenty-four hours. The idea was to represent conditions as they would occur in practice. All the guinea-pigs inoculated with scrapings from these blocks developed tuberculosis. To emphasize the mechanical removal of infection for the good it does and to sanction the use of disinfectants on general principles, is a safe and sane stand to take on the disinfection question in the light of what we know to-day.—*Making Cattle Environs Free from Infection by Eliminating Tuberculous Cattle, J. Traum, J. Am. Vet. M. Ass., December 1917, lii, No. 3, 289 (from Veter. Rev., May 1918, ii, No. 2, 207.)*

Tuberculin Test and Retest.—The authors consider the subcutaneous test as superior to all other tuberculin tests, and recommend that it should be used on all cattle above six months of age. In animals under six months old, the intracutaneous test should be used, and, where possible, it should be combined with the ophthalmic or intrapalpebral test. Where 10 per cent, or more of a herd react, a retest should be made with retest tuberculin and ophthalmic tuberculin in from four to seven days. When applying a retest, the left eye is sensitized by placing within the eyelid two or three drops of a 4 per cent solution of a specially prepared ophthalmic tuberculin three days after the original test. On the seventh day after the original test the same eye is dropped with an 8 per cent solution of ophthalmic tuberculin, and the animal is injected subcutaneously with a specially prepared tuberculin which contains 1.2 cc. of crude tuberculin. The reaction occurs earlier in the retest than in the original test. The authors further recommend that the semi-annual subcutaneous testing of herds should not be continued, as too frequent tests lessen the sensibility of the animals to tuberculin. When a semi-annual test is required, the ophthalmic test only should be used.—*Tuberculin Test and Retest, C. I. Marshall T. & H.W. Turner, J. Am. Vet. Ass., lii, No. 3, 308, December 1917 (from Veter. Rev., May 1918, ii, No. 2, 206.)*

Tuberculosis and Blastomycosis.—The lungs of tuberculous cattle constantly contain blastomycetes and other fungi. Among the blastomycetes are some species pathogenic for laboratory animals and fowls, and in shape and cultures not distinguishable from the *Saccharomyces neoformans*. Associated with tubercle bacilli, animals inoculated died more rapidly than the controls inoculated with the tubercle bacilli alone, and the tissues show both diffuse tuberculosis and blastomycosis.—*Tubercolosie blastomicosis, F. Sanfelice, Ann. d'Igiene, February 28, 1918, xxviii, No. 2, 49.*

Primary Laryngeal Blastomycosis.—The patient, a man aged thirty-seven, was sent to a sanatorium with the diagnosis of tuberculous laryngitis. No evidence of lung trouble had been detected and no tubercle bacilli were found in the sputum. The trouble started a few days after the man had cleaned out some old wood from the bottom of a grain elevator shaft; it began with symptoms of a severe cold with coughing and sneezing, but no sputum. Chest examination was negative. He had pyorrhea alveolaris. There was marked hoarseness with pain in the ear. On the right tonsil there were two pin-point yellowish spots. The epiglottis was eroded,

the lesion extending well into the tongue. There was absent the marked swelling and enlargement seen in tuberculosis. The mucous membrane of the larynx and cords looked as if they had been treated with silver nitrate; on closer inspection many small slightly elevated yellowish spots were seen. A piece of tissue was removed for examination and showed the presence of blastomyces. In one of many smears made from the larynx a few parasites were also found imbedded in a bunch of cells.

Large doses of potassium iodide and local applications of the tincture of iodine were followed by no improvement. He had a sudden attack of choking and an immediate tracheotomy had to be performed. The lungs became involved and he ran a temperature similar to tuberculosis. Cyanocuprol also proved of no avail, and he died fourteen months after the onset of the disease.—*A Case of Blastomycosis with Laryngeal Involvement. E. D. Downing, J. Am. Ass., January 12, 1918, lxx, No. 2, 85.*

Maternity and Tuberculosis.—When an adult becomes ill with tuberculosis, it is comparatively useless to enquire for the source of the infection; the real line of inquiry is as to what caused the break-down. The tubercle bacillus, which may have lain harmlessly in the tissues for years, is, after all, only the remote cause of the disease. The real cause is the debilitating condition which gave the bacillus the opportunity. The term "break-down" is used by the author to designate this weakening influence which leads to the development of tuberculosis in the adult. Two hundred cases are selected by the author from the records of the Manitoba Sanatorium; they were undoubted cases of tuberculosis, all married women, with maternal histories fairly adequately recorded. They were classed as: incipient, 8 per cent; moderately advanced, 16 per cent; and far advanced, 76 per cent. Sixteen per cent of the last class were classified on admission as "apparently hopeless." The whole 300 cases were about 20 per cent farther advanced than the average of 1900 patients of both sexes treated during the period of seven years. Of the 200 cases, 11 per cent died in the sanatorium; 28.5 per cent have since died; 8 per cent are known to be doing badly; 28 per cent to be doing well; and the remainder, 24.5 per cent have been lost track of. The results are so definitely worse than the average that there may be a fair presumption of specific lack of resistance in tuberculous mothers. The greatest proportion of break-downs occurred during the puerperium, 24 per cent per month; during lactation and pregnancy about 3 per cent per month; while during the interval between pregnancies only 1 per cent per month. Very early pregnancy was a definite element in break-down. Laryngeal involvement is even a more serious complication in the pregnant woman than it is in other series. Of 31 women with marked disease of the larynx, only six are living. The conclusion cannot be avoided that child bearing has a definite place in the etiology of tuberculosis. It can break down resistance and cause a flare up of old pre-maternal tuberculosis; and, on the other hand, added to other burdens, it can definitely cause initial break-down in one who has not before shown evidence of the disease. For a woman who already has a definite history of tuberculosis, that is, carrying a mortgage, child-bearing is a very risky speculation. If it is ever to be considered, all resources must first be investigated, the cost must be counted, the reckoning made up before hand. Pregnancy should never be allowed in a woman who has ever reached the anatomical far-advanced stage, or ever had far-advanced symptoms. It should never be allowed in the presence of active symptoms, however slight, or connected with however slight a lesion. It should never be allowed until the disease has been quiescent and the sputum free from bacilli for at least three years. When pregnancy has begun in one whose disease is advanced or active, definite increase in symptoms should not be waited for. Pregnancy should be terminated without delay. And when in one with apparently quiescent disease and apparently able for the strain of child-bearing, any freshening up of signs of disease occurs early in pregnancy, no time should be lost. Termination of pregnancy in the early months gives better results than allowing gestation to proceed. It should not be attempted after the fifth month. If pregnancy is allowed to proceed labor should be induced a little before term, and forceps and anaesthetic used to make labor as easy as possible. A tuberculous mother should under no circumstances nurse her child, partly because of danger to the child, but just as much because of great danger to herself.—*Tuberculosis and Maternity, D. A Stewart, Publ. Health J., May 1918, ix, No. 5, 221.*

Tuberculosis and Pregnancy.—The literature on this subject is full of contradictory statements. This is due to the fact that pregnancy, labor and puerperium are usually treated as a causal unit and on the other hand tuberculosis is spoken of as

a generality instead of the various forms and stages. The prevailing opinions are reviewed from different points of view:

1. How does an existing tuberculosis of the lungs or other organs affect the pregnant woman and her child? Only very rarely will the fetus be infected in utero. The pregnancy is likely to be interrupted by the severer forms of tuberculosis. The newborn often inherits a tuberculous predisposition. Still, a weak tuberculous mother may give birth to a strong child; and if the latter should acquire tuberculosis later on, the disease need not run a more unfavorable course than in other children.

2. How does pregnancy affect an existing tuberculosis? Most writers say: Unfavorably. The author sides with those who say: not necessarily.

3. How is the harmful effect of pregnancy on tuberculosis produced? The pregnant woman often loses much of her food by vomiting, must feed the child and at the same time carry on the fight against her disease. She sacrifices herself to the fetus. The toxins of pregnancy can also unfavorably affect tuberculous lesions. But more important are the mechanical effects. The author summarizes his personal opinion as follows: Usually pregnancy affects an existing pulmonary tuberculosis unfavorably, often it has neither a good nor a bad effect and not rarely is its action on the disease distinctly favorable. In these latter cases pregnancy acts on the lung by compression in the manner of a slowly increasing pneumothorax. It depends on the type and extent of the lesion whether this compression will produce a favorable or unfavorable effect.

4. During labor softened portions of the lung or pleuritic adhesions may rupture; contents of cavities may be squeezed into normal bronchi, tuberculous foci in the placenta may tear and infect the child or mother. Miliary tuberculosis thus produced may simulate puerperal sepsis.

5. It is the consensus of opinion that during the puerperium tuberculous women as a rule rapidly go downhill, one of the deleterious factors being the rapid expansion of the lungs after delivery. The writer regards this mechanical factor as more important than all the others.

Prophylaxis. The French saying holds good: "Jeune fille — pas de mariage; femme —pas d'enfants; mere—pas d'allaitement."

Treatment. The question of interruption of pregnancy has to be considered in every pregnant tuberculous woman. Every case has to be decided on its own merits. The activity of the process will furnish the answer. Before a pregnancy is interrupted on account of the activity of the pulmonary lesion, a specialist in pneumothorax therapy should be consulted and settle the question whether the pulmonary tuberculosis could not rather be inactivated by an artificial pneumothorax. In such a case abortion should not be performed unless the establishment of an artificial pneumothorax is either not indicated or impossible. Eight cases are mentioned from literature.

Van Voornveld describes in detail a case of his own. Twenty-eight year old IIpara with advanced pulmonary tuberculosis showing progressive tendencies during the first months of gestation is treated with artificial pneumothorax in the sixth month. The fever ceases, tubercle bacilli and elastic fibres disappear from the sputum. Pregnancy progresses as in a normal woman. An optimum pressure is carefully kept up. The dangers to which the lung is subjected by the expulsive labor pains were considerably lessened through the presence of the easily compressible aircushion. Normal delivery and normal puerperium. The pneumothorax is being kept up. The mother has gained weight, feels well and has no tubercle bacilli in the scanty sputum. The author is firmly convinced that in his case certainly the child and in all probabilities the life of the mother have been saved by means of the pneumothorax. —*Tuberkulose und Schwangerschaft.—Neue Perspektiven fuer die Behandlung, van Voornveld, Corr.—Bl. f. Schweiz. Aerzte, 1917, No. 22.*

Pregnancy and Pulmonary Tuberculosis.—Thirty-eight patients had, after recognition of their tuberculosis, 50 children. Five of them are dead. In 27 the disease was recognized and treated before pregnancy and in the majority before marriage. These 27 had 93 children; 16 were early, 4 moderately advanced, and 7 far advanced cases. Of these 27, 2 died (7 per cent), 1 about three months, the other about one year after delivery; the former patient, a far advanced case, became pregnant about four years after treatment; the latter, an early case, one year after. The remaining 25 are apparently as well as before pregnancy, though 3 have had 3 children and 6 have had 2 children. The pregnancies occurred one to twelve years after treatment, the average being four years. In 11 the disease was recognized during pregnancy, one being early, 5 moderately advanced and 5 far advanced. Of these 11, 3 died (27 per cent), one of these 3 being first seen five days before delivery, 1 twelve days, and 1 two months. In other words, there was no chance for treatment of the first 2 and very little for the

third. All three were far advanced cases. Of the remaining 8, 2 far advanced cases seen for the first time at the fifth month, are still under treatment. One was a primipara, the other a sextipara, the latter from her history having had tuberculosis even before the birth of the first child. The remaining 6 came through successfully and are still alive after periods of time varying from three months to thirteen years, the average being two years. On the basis of this experience Walsh advises that active cases of tuberculosis should be advised against marriage; quiescent cases especially after treatment and education bear the duties of marriage sufficiently successfully that if they wish to marry they may be allowed to do so. Quiescent cases becoming pregnant, if put on a rigid régimé, may be expected to come through the pregnancy with but little, if any, advance of the tuberculosis. Active cases becoming pregnant run definite risk, yet the operations for abortion, especially those associated with sterilization, have a mortality making the continuation of the pregnancy more desirable.—*Pregnancy in Cases of Tuberculosis of Lungs, J. Walsh, Am. J. of Obst., and Dis. of Women and Childr., February 1918, lxxvii, No. 2, 292.*

Modes of Invasion.—The point of election and modes of invasion in pulmonary tuberculosis are discussed. It is generally admitted that the peribronchial glands are first involved in what is called the pretuberculous stage, and the problem is to analyze the common anatomic methods or routes by which tubercle bacilli reach the points where they are arrested and colonized. Minute particles of carbon, stone, etc., have reached lung tissue, but this fact does not prove that it was carried there in the ordinary process of respiration as this function is commonly understood. One, however, cannot avoid the conviction that foreign bodies might reach the mucous membrane of the bronchioles in the tidal air. A histologic feature must be considered. The minute, terminal branches of the bronchioles are not supplied with cilia, and if the foreign bodies reached these points the pull of the adjacent lymph streams would draw them back in the air sacs, and thence to the lymphatic glands and vessels of the lungs. The experimental work of Cornet, confirmed by others, seems to have proven this. The possibility of infection through the tonsils is not credited by Cobb. The possibility of foreign matter reaching the lungs through the intestinal tract seems to have been demonstrated. It is reasonable to assume that in whatever way the cow is infected it will be found anatomically the same in man. Those who think that milk is the agent carrying tuberculosis are confronted with the confusing fact that the cow herself is not a milk feeder, notwithstanding her marked susceptibility to tuberculosis. Contiguity in cattle seems to be essential in the infection of herds. In cattle the point of election seems to be different from that in man, but in both the highest portion of the lung which is the apex in man, and the caudal lobe in cattle, are the first infected, and both are best supplied with lymphatics. There the germs find their point of election. With the experimental evidence at hand, it is a fair assumption that infection is commonly by the ingestion method in man and animals. The number of bacilli that were swallowed is out of all proportion to the very doubtful number that might possibly reach the air vesicles by inhalation. Granting that infections are commonly by the intestinal tract does not lessen the potential danger of infected dust, as much of this dust would be swallowed, even though planted on respiratory mucous membranes by inhalation. No portion of the lung has any specific biochemical constituent, sensitizing it to the tubercle bacillus, and the selection of a specific area for the invasion must be wholly from physio-anatomic causes.—*The Point of Election and Modes of Invasion in Pulmonary Tuberculosis, J. O. Cobb, J. Am. M. Ass., lxx, No. 21, 1511.*

Pathological Classification of Tuberculosis.—Although it is rare to find a tuberculous process consisting of a single stage if the disease has been existing for some time, Gammons would classify a case of tuberculosis according to Rathbun's modification with the addition of its descriptive pathology. According to the pathological changes the disease is either inflammatory or ulcerative. Each type can then be subdivided into fibro-inflammatory and fibro-ulcerative. By stethoscopic examination, observation of the sputum and the use of x-ray these types can usually be differentiated. By a study of the constitutional symptoms the case may then be classed as: fibro-inflammatory of the incipient, moderately advanced, or advanced stage as the case may be, and so on. The treatment differs for these various types. Thus, the moderately advanced ulcerative case often requires longer rest than the advanced fibro-inflammatory. The latter, without constitutional symptoms, has not only developed his immunity but he has also developed a great mechanical resistance

in the affected areas and will often do better and live longer, with proper treatment, than the active inflammatory type of the incipient stage.—*Pathological Classifications of Pulmonary Tuberculosis, H. F. Gammons, Boston M. & S. J., June 13, 1918; clxxviii, No. 24, 809.*

Lung Volume.—The authors investigated the lung volume in normal, and in tuberculous men and women. They employ the following terms: "vital capacity," the amount of air a person is able to expire after a maximum inspiration; "residual air," the air remaining in the lungs after a maximum expiration; "total capacity or volume," the sum of the former two; the "middle capacity," the air present in the lungs midway during an expiration or inspiration; "reserve air," all the air that can be breathed in after a half expiration; and "complementary air," all that can be breathed out after a half expiration.

Two methods were used in the investigation, the spirometer and the mixing method. The vital capacity of the average normal man is given as 1.5 liters; woman, 1 liter. The reserve air for man 2, for woman 1.5 liters. The mean capacity for man 3.5, woman, 2.5 liters. Complementary air: man, 2.5, woman, 2 liters. Total capacity for man 6, woman, 4.5 liters. By calculating the chest volume from measurements taken of the height, antero-posterior and transverse diameters of the chest a method is given for finding a numerical relationship between external chest measurements and lung capacity. The lung capacity normal for a chest of given measurements can thus be ascertained. The average ratios found were: 55 for the total capacity; 37 for the middle capacity; and 19 for the residual air. The figures for lung volumes agree closely with those of other investigators.

Of the 31 tuberculous men studied, 9 were incipient cases. The most conspicuous difference in this group from the normal individuals is that the vital capacity is moderately diminished due to an increase in the residual air.

In the moderately and far advanced cases, which numbered 22, the most striking difference was also a diminution in the vital capacity. In this instance, however, the decrease is due to a decrease in the total capacity. The total capacity was found to be within normal limits only in seven of the cases. The residual air was in most of the patients fairly normal. The cause for the diminished total capacity is that the lungs do not have so much air space as in normal persons.

The results of the determinations in the cases of incipient pulmonary tuberculosis in women confirm the findings in men. In one case showing a decrease in the total capacity it was found that the subject was afflicted with miliary tuberculosis. In the women with advanced tuberculosis the findings were the same as in the corresponding group in men.

The movements of the diaphragm were studied in all and found restricted in the tuberculous cases.—*Studies of Lung Volume. Relation between Thorax Size and Lung Volume in Normal and in Tuberculous Men and Women. A. Garvin, C. Lundsgaard, and D. D. Van Slike, J. Exper. M., January 1, 1918; xxvii, No. 1,65, 87, and 129.*

Hemoptysis and Blood Coagulation.—The authors undertook a study of the coagulation time of the blood of tuberculous patients in order to ascertain the relation, if any, between this property of the blood and the tendency to hemoptysis. One hundred and twenty patients were studied; the number of specimens was 132. Eight of the patients were probably non-tuberculous; of the remaining, 73 were open cases and 47 closed. Of all the cases, 54 per cent gave histories of hemoptysis. The average clotting time was seven minutes and forty five seconds. Grouping the cases according to coagulation time, occurrence of hemoptysis, and stage of activity of the disease process, there was no striking demonstration of results. The coagulation time of twelve cases with recent hemoptysis averaged eight minutes thirty seconds, only a few showing an increased coagulation time. The average coagulation time of another group of twelve patients without hemoptysis and with disease processes parallel to the latter group was the same, with about the same number showing increased coagulation time.

The indirect method of determining blood coagulation time may produce variable results when applied to pathological conditions.—*Coagulation Time of Blood Specimens from Tuberculous Patients, N. B. Burns and A. E. Young, Am. J. M. Sc., December, 1917, cliv, No. 6, 797.*

Pathology of Bronchial Glands.—The author remarks that modern methods have made it possible to determine whether enlarged bronchial glands are responsible for stenosis of the air passages, and also permit direct treatment. In 1902 only three cases were known of recovery after operative treatment of glands perforating into the bronchi. Sternberg reported in

1905 that he had found perforation into the bronchi in 36 of 6132 cadavers, but anthracosis was responsible for it in 34 and tuberculosis only in 2. Reports from the Middlesex Hospital mention perforation found in 0.3 per cent of 1800 cadavers, while some German reports mention 3.2 per cent in 796 cadavers. It is probable that the perforation into the air passages or the esophagus has often escaped detection during life and at necropsy. Enlarged glands may likewise be responsible for sudden suffocation, and Schmiegelow reports some cases of this kind in children, and tabulates 20 from the literature. One girl of nine was apparently healthy until she suddenly developed cyanosis and coughed up large masses from a tuberculous gland perforating into the bronchus. This is the most dangerous form of glandular trouble on account of the lack of any warning symptoms. One child of nearly three was under treatment in the hospital for caustic stenosis of the esophagus when the symptoms from the perforation into the bronchus became apparent. Tracheotomy was done at once and the child recovered. He has found only one case on record of perforation of this kind in an adult, but has encountered one case himself.

The symptoms of stenosis from compression by enlarged glands are the difficulty in expiration while inspiration proceeds with comparative ease; the cough, which resembles that of whooping cough and occurs spasmodically; an area of dulness over the interscapular region; and the peculiar whistling character of the respiration. But these symptoms are not always present. One babe of eight months succumbed to suffocation from compression of the trachea by enlarged glands, but they were simply hypertrophied with no signs of tuberculosis. Glands may be the seat of a tuberculous process without inducing symptoms, but they usually enlarge. With suppuration and perforation into a bronchus, the patient may cough up the extruded masses and recover. But if they are too voluminous to be coughed up, the child suffocates if operative measures are not applied in time. Sudden death from this cause may suggest a criminal factor. Symptoms of stenosis should warn of trouble. Direct bronchoscopy is indicated at once; it may prove possible to aspirate through the bronchoscope the contents of the gland that have broken through into the bronchus. When the tuberculous glands are in the anterior mediastinum, they can be reached as a rule only by removing the sternum. Dalziel reported 3 cases of this kind in 1915. In one case a suppurating gland was found close under the arch of the aorta. In 14 of the tabulated 20 cases the suffocation occurred without warning, and 9 of the patients died. One child of five was intubated and tracheotomized for assumed diphtheria, but he finally coughed up the tuberculous gland masses and recovered. One boy was treated with artificial respiration, and this forced the coughing up of the masses. One child only eleven weeks old had the tendency to suffocation keep up for five days, and then it coughed up a tuberculous gland. Two of the patients were men; tracheoscopy showed the trachea compressed. The outcome in these cases is not known. In 2 other men enlarged glands had perforated into both trachea and an artery, and fatal hemoptysis followed. There is no doubt that if the trouble had been differentiated earlier, more lives could have been saved by direct tracheoscopy, etc. Tracheoscopy is especially useful in cases developing gradually, as the best mode of treatment can then be determined with confidence. For children under six, tracheotomy is indispensable for tracheoscopy, but for older children and adults the natural passages suffice.—*Hospitalstidende, January 30, February 6, 1918, 61, No. 5 and 6. Beidrag til Bronchial glandal tuberkulous Pathologi, E. Schmiegelow.*

Prognosis in Tuberculosis.—The various prognostic tests based on laboratory methods are not reliable criteria for the prognosis in pulmonary tuberculosis. The presence of bacilli in the sputum or their absence is not to be relied upon; many acute cases run a rapid course without revealing bacilli, while many patients expectorating bacilli for years live and do well. The enumeration of bacilli in the field is also of no value. Other special tests which the author characterizes as "short cuts," and which are not of much value are: the various methods of applying the cutaneous test, the diazo and urochromogen reactions of the urine, Arneth's blood picture, and the complement fixation. The same is said about the classification of the disease into stages. A first stage case with active symptoms has a poorer chance than another with extensive involvement but with few or no constitutional symptoms. Patients showing stigmata of present or past extrathoracic tuberculosis are, as a rule, not in greater danger than the individuals with well-developed chests who have been in excellent health all their lives and have never had tuberculosis. Phthisis developing after surgical operations on bones or joints, however, is apt to be of a very rapid and fatal course. The extent

of the lesions in the lungs is no prognostic criterion. Cases with initial active phthisis showing slight or indefinite extent of lung involvement offer a poorer prognosis than those showing well defined lesions. Left sided lesions are more dangerous than those in the right lung, probably because the left lung is smaller and has only one interlobar fissure, and also because of displacement of the heart and traction on the diaphragm and stomach. The prognosis varies inversely with the time it takes from the onset of active symptoms to the development of cavities. Cavities are less dangerous in the upper lobes than in the lower; the latter are terminal phenomena and when occurring in the usual case, which is very rare, the prognosis is poor, because they do not drain as well as cavities in the upper lobe. Experience has taught that the prognosis in phthisis is good as long as the pulse is normal, and, conversely, the prognosis is very serious when the rate is persistently high, especially when the tachycardia is not improved by rest. A pulse which remains unstable, becoming rapid after exertion, excitement or worry makes the outlook poor as regards recovery. Of similar unfavorable omen is paroxysmal tachycardia occurring in a tuberculous patient. A low blood pressure is not of good omen; the lower the blood perssure the worse the outlook. Patients with high blood pressure, subjects of chronic nephritis, gout, rheumatism, etc., last very long when affected with tuberculosis, especially if the blood pressure continue high. A normal temperature which does not rise high after exertion offers the tuberculous patient excellent chances of recovery. The higher and the more continuous and protracted the fever, the worse the prognosis. A hectic fever with rises of 103 or 105 in the afternoon and normal temperature in the morning is also unfavorable. A record of the pulse and temperature for a period of two weeks at least is imperative before giving a prognosis. Other constitutional symptoms which render the prognosis bad: the laryngeal cough, the paroxysmal and unproductive cough, the emetic cough, anorexia, persistent diarrhea. Hemoptysis is not a serious accident when it takes place in an incipient case; the patient always survives this accident. Only 2 per cent of deaths at the Montefiere Hospital are caused by hemoptysis. Hemorrhage during the advanced cavitary stage is more dangerous; a cavity may fill up with blood and literally drown the patient. Bleeding at this stage may be due to erosion of a large branch of the pulmonary artery and the patient succumb in a few minutes. Broncho-pneumonia is only apt to follow hemorrhage where the latter has been preceded by acute progressive lesions. Such complications as concomitant renal disease, mitral stenosis, arteriosclerosis, gout, rheumatism, etc., do not aggravate the prognosis; in fact, in such cases, the phthisis is seldom progressive. This is probably due to the tendency to cicatrization in these conditions. Syphilis occurring in a consumptive renders both diseases grave, but where phthisis develops in one who had syphilis for many years, the prognosis is very good. Similarly, bronchial asthma, chronic bronchitis and emphysema preceding the onset of phthisis indicate that the progress of the tuberculous process is likely to be mild. Pleurisy preceding phthisis is also of favorable import. This is due to the immobilizing influence of the effusion and fibrous tissue. Fluid should, therefore, not be aspirated. Empyema is of grave significance, operative interference is unsatisfactory and only tapping should be practised. Seldom does spontaneous pneumothorax prove of benefit; as a rule it is a grave complication. The same is true of laryngeal involvement. Of serious prognostic significance is amenorrhea which persisted for many months in a tuberculous woman. During pregnancy there may be a temporary improvement, but very often there is a severe exacerbation soon after labor which may carry off the woman. In the vast majority of cases promptitude of diagnosis and early treatment have little or no influence on the prognosis. All methods of treatment give the same proportion of "recovered," "improved," "unimproved," and dead, although in some active and progressive cases the chances of recovery may be improved by the induction of artificial pneumothorax. But the number suitable for this method is very limited.—*Prognosis in Pulmonary Tuberculosis, M. Fishberg, N. York M. J., June 22, 1918, cvii, No. 25, 1167.*

Prognosis in Pulmonary Tuberculosis.—Pulmonary tuberculosis is still "one of the most relentless enemies of the human race," but since the discovery of the tubercle bacillus, of methods leading to early diagnosis, and of the value of the hygienic dietetic treatment it has become also one of the most curable chronic diseases. The only hope of a favorable outcome rests upon the development of a good resistance. Prognosis, therefore, depends largely upon observed results of treatment. Among the valuable indications upon which one may base a prognosis are the following: (1) The previous life and habits of the

patient. When an individual who has led a regular, careful life develops the disease his chances are not as good as of another individual who led a careless existence, indulged in overwork or other excesses. The latter will probably get well under the change to proper hygiene. (2) The character and intelligence of the patient. (3) The habits, social and domestic relations and the financial ability to secure treatment. (4) While an insidious onset of disease is of no special prognostic significance, a rapid, acute onset is of unfavorable omen. (5) The extent and rapidity of lung involvement is very important. Increase of moisture in the diseased portion as shown by number and size of râles is an unfavorable sign. (6) The presence or onset of any complication, especially laryngitis, diabetes, or other chronic or acute diseases. Pleurisy is not of bad significance and may even influence favorably the disease. (7) Pregnancy, bad digestion, and when the disease comes on after an acute infection like influenza, measles or pertussis all point to an unfavorable outcome. (8) A rapid pulse, loss of weight and fever indicate an unfavorable prognosis while hemoptysis occurs in 50 per cent of cases and is not of much significance. Finally the ability to resist the toxemia is the most important criterion.—*Prognosis in Pulmonary Tuberculosis, E. O. Otis, Arch. Diag., October, 1917, x, No. 4, 394.*

Comparative Gravity of Pulmonary Tuberculosis on the Left or Right Side.—The authors have been struck with the large number of cases in which artificial pneumothorax has been induced for disease in the left lung as compared with the much smaller number done for disease in the right. This would indicate the greater frequency of severe lesions in the left lung. Two thousand cases of pulmonary tuberculosis under treatment at Leysin and observed for from five months to several years were classified with this point in view.

First stage: 516 cases
- 142 left lung lesions with 1.12 per cent progressive.
- 374 right lung lesions with 0.46 per cent progressive.

Second stage: 1052 cases
- 472 left lung lesions with 7 per cent dead and 14 per cent progressive.
- 580 right lung lesions with 3 per cent dead and 6 per cent progressive.

Third stage:
- Without cavities, 109 cases.
- 64 left lung with 44 per cent dead and 22 per cent progressive.
- 45 right lung with 55 per cent dead.
- With cavitation, 323 cases.
- 205 left lung with 38 per cent dead and 31 per cent progressive.
- 118 right lung with 27 per cent dead and 19 per cent progressive.

From these figures the authors consider the conclusion justified that a tuberculous condition in the left lung is more serious than one in the right and consequently should demand a more guarded prognosis. As to the cause of this difference attention is called to the angle and calibre of the bronchi, the relative size of the lungs, and especially to the interlobar fissures, which may play a defensive rôle.—*Gravite é comparée des localisations, tuberculeuses pulmonaires gauches et droites. Etude de 2000 cas, Tecon et Aimard, Rev. méd. d. l. Suisse Rom., January and February 1917, xxxvii, No. 1, 45.*

Relative Values in Anti-Tuberculosis Work.—The prophylactic measures used to combat tuberculosis may be classed under four headings: the prevention of infection, the cure of the disease, the predisposing factors, and public health nursing.

Regarding the prevention of infection, it is apparent that the problem is a vast one, and since relatively so small a number of persons acquire the disease in its active form, it is perhaps not the solution of the problem. The early diagnosis of cases to prevent active foci of the disease, the hospitalization of active cases, thorough disinfection of the discharges, proper instruction of both patient and attendants and exposed persons, and the exclusion of tuberculous food-handlers from this employment, aid in the prevention of the disease. These measures are recommended for the purpose of reducing repeated and massive infection. The encouragement of routine physical examination of school children, adult employees, and of all persons is an anti-tuberculosis measure of the first magnitude. The sanatorium is not indispensable in the program for cure; each case must be judged separately and where facilities for home treatment are not lacking, the patient should remain at home. The sanatorium is for the very poor and the ignorant primarily. Out of door schools for all children with poor physique should be rapidly extended. The predisposing factors in tuberculosis are enumerated as follows: inheritance, malnutrition, alcoholism and other drug addictions, occupations which are attended with the exposure of the worker to dust, to bad air, to excessive heat and noxious gases, to close confinement and to poor postures. The elimination of child labor, the minimum wage scale, health insurance and other sociological industrial elements are highly important. The pre-

vention of typhoid fever and the other diseases which predispose to tuberculosis, the elimination of poverty and its concomitants are very important preventive measures. The latest item in the fight against tuberculosis is the public health nurse. Her function consists of: the prevention of the spread of infection and the detection of new cases; the instruction and nursing of patients at home, coöperation with agencies which may help the patient; assistance at clinics and dispensaries. The educational work of the public health nurse ranks first in prophylaxis. The relative values in anti-tuberculosis work are given as follows: Avoidance of infection, 20. The items coming under this heading are: unlimited protection up to four years of age, 10; hospitalization of open cases, 4; disposal of sputum, 3; prevention of bovine infections, 3. The detection and cure of the disease has a rating in anti-tuberculosis work of 16. Of this number of points, early detection receives 7; prompt reporting to authorities and to the patient and his family, 3; modern treatment, 4; open-air schools, 1.9; and tuberculin, 0.1. The elimination of predisposing causes is worth 39. The most important items under this heading are: avoidance of fatigue, 10; adequate nutrition, 10; occupation, 5; povverty, 7; preventing other predisposing diseases, 5. Public health nursing has a value of 25, of which the educational work is rated at 15.—*Relative Values in Anti-Tuberculosis Work, C. M. Hilliard, Boston M. and S. J., June 20, 1918, clxxviii, No. 25, 853.*

How to Avoid Tuberculosis.—The average person does not get tuberculosis except after prolonged exposure, and then only under most adverse living and working conditions. To avoid the disease, it is the duty of every person to observe the following rules: Stop careless spitting. Keep the place in which you live and work absolutely clean, and prevent the formation of dust. Insist upon having fresh air and sunlight at all times and in all places. Never occupy a new home until it has been thoroughly cleaned and aired. Keep clean in body and mind and be moderate in all things. Do everything you can to make life healthier and happier by better wages, better working hours, better food at lower prices, etc.—*How to Avoid Tuberculosis, O. R. Eichel, N. York M. J., January 26. 1918, cvii, No. 4, 161.*

Lymphocytes and Resistance.—The pressure of lymphocytes about the tubercle, their abundance in certain pleural exudates, the interesting points brought out by the x-ray (destruction of lymphoid tissue, increased susceptibility of x-rayed guinea-pigs to tuberculous infection) and their fluctuation in the blood with the progress of the disease justifies the assumption that a lead through the lymphocytes has been found toward the secret of resistance in tuberculosis. The authors have done routine blood counts during the past two years at the Modern Woodman Sanatorium when patients entered and six to nine months later on their leaving. In 9 pneumothorax cases the lymphocytes invariably increased after compression.—*Lymphocytes and their Relation to Resistance in Tuberculosis, E. D. Downing and J. L. Allison, Col. Med., March, 1918, xvi, No. 3.*

Resistance to Tuberculosis.—That changes in the ferment and antiferment content of the blood play a leading rôle in the individual's resistance to tuberculosis and that tuberculin reactions are independent of specificity, is the theme of the author's article.

The quiescent tubercle represents a balance between the digestive and digestion inhibitory forces; that is, it serves as a potential source of toxic split products derived from the necrotic material, potential rather than actual, because the active autolysis and removal into the circulation of the products of autolysis is prevented by the antiferment. Any factors that will alter the condition of this delicate balance so that autolysis can occur will bring about a toxic reaction, that is, a tuberculin reaction. This may be brought about if we increase the ferments of the serum, or decrease the antiferment of the necrotic focus or of the serum. Such alteration need have no relation to specificity.

During the early stages of pregnancy the protease begins to attack the fibrous connective tissue wall of the tubercle, small amounts of toxic material are liberated from the caseous focus, this in turn causing some local reaction on immediately adjacent tissues. A coincident increase in the antiferment acts to counterbalance to some extent the effect of the protease with the result that we may have a focal activation but also a more or less detoxication of the patient and a feeling of well being.—*Factors in Resistance to Tuberculosis, Wm. F. Petersen, Arch. Int. Med., January, 1918. xxi, No. 1, 14.*

Artificial Pneumothorax.—Thirty-two cases of pulmonary tuberculosis, in private and dispensary practice were treated by an artificial pneumothorax of nitrogen gas.

The report disproves the necessity of sanatorium treatment and causes the profession to realize that a great deal can be done for the many patients at home, unable or unwilling to seek the western sanatoriums for relief. Nineteen men and thirteen women were treated. A Floyd-Robinson apparatus was used, and the operation was, performed under procain and epinephrin anesthesia. The physical examination was in most cases, supplemented by careful roentgen-ray examination. An effort was made to use only unilaterally involved cases, but this was not always possible. Twelve of the patients had involvement of the untreated lung, which was of a more or less inactive type. An area without cavities and râles in the untreated side, even if rather extensive in a lobe will give a better prognosis than a small active surface in that lobe. It is unwise to treat any case, except palliatively, which presents a tuberculous focus in the untreated basal lobe. Pleural adhesions should be at least limited or still better, absent. The technic is comparatively simple, and the operation safe if the indications are rigidly followed, and with a well marked Litten's sign and fair basal excursion, and absence of marked chest retraction, one may assume that troublesome adhesions are absent. Six cases are reported, and he says that a method that will bring about arrest in 44 per cent of his thirty-two cases should have a well established place in the therapeutics of the disease. First-stage cases unilaterally involved should have this method tried and the time is not far distant when this will be more generally done.—*Artificial Pneumothorax in the Treatment of Pulmonary Tuberculosis; Results in Private and Dispensary Practice, A. E. Greer, J. Am. M. Ass., June 1, 1918, lxx, No. 121.*

Artificial Pneumothorax.—A new and simple apparatus is described and illustrated, which seems to work very well. It costs practically nothing, requiring only one bottle, the gas container. The gas in this bottle is displaced by water which enters from a funnel. The bottle may be of any size, one of about a liter capacity being shown in the illustration. The whole apparatus can be carried in a small handbag.—*Apparatus for Artificial Pneumothorax, Ch. M. Montgomery, J. Am. M. Ass., June 13, 1918, lxxi, No. 2, 107.*

Phototherapy and the Air Cure in Surgical Tuberculosis.—Brunon pleads for more widespread recognition of the benefits of light and air, and less routine hospital treatment. He reports the case of a boy of fourteen years with multiple tuberculous bone lesions who, after remaining in a hospital bed for a long period and being subjected to repeated curettage of the diseased foci, one day disappeared. A few months later he returned almost unrecognizable, having grown, filled out, walking without difficulty and with sinuses nearly all closed. It was learned that, despairing of recovery in the hospital and longing to live unrestrained in the country, he had had himself helped over the hospital wall, and had wandered from farm to farm, generally sleeping in the open air, rain or shine, and begging food from peasants. In a few days his dressings had all been pulled off by thorns and he was merely wiping his wounds with grass or leaves and leaving them uncovered. Winter had brought him back to the hospital for shelter; all the benefit from his escapade was soon lost and after a few months he succumbed to tuberculous meningitis. Such a case from the start should have at least been out of bed in the hospital garden for a few hours a day. Another case, a young man of twenty, had long standing hip disease with numerous sinuses. Excision of the head of the femur yielded improvement, but, in the subsequent months, the condition became very grave. The family took the patient back, that he might die among his kin, and the following measures were instituted: Starch enemas, raw meat, general alcohol rubs, and an air and light cure at the open window. Twice daily the affected tissues were exposed for a few minutes to diffuse light. A nurse taught the mother to apply antiseptic dressings. Within two weeks diarrhea ceased, and the general condition improved in the succeeding months. Three summer months in the country did no good, loneliness and absence of the family being keenly felt. Upon return to town in the fall and resumption of the open window treatment progressive improvement began at once. Soon he was able to walk with a special shoe, the general condition was good, and but little suppuration remained. In this case, air and diffuse light saved the patient.—*Heliothérapie, photothérapie, cure d'air, R. Brunon, Presse méd., February 21, 1918, No. 11, 100.*

Chemotherapy in Leprosy and Tuberculosis.—Potassium cuprocyanide is a combination of 2 parts potassium cyanide and 1 part of cuprous cyanide. An injection was given to patients every ten days; the dose being 0.25 to 0.3 mgm. per kilogram of body weight, using a solution of 0.1 to 1 per cent in water. The substance was also tested on experimental animals.

In one series of tests five rabbits were injected into the liver with doses of 1 mgm. of tubercle bacilli and followed by an injection intravenously of 2 to 4 cc. of a 0.1 per cent of aqueous solution of potassium cuprocyanide. One animal was kept as control. The rabbits were killed after twenty-three days and examined. There seemed to be an inhibition in the distribution and in the number of the tubercle bacilli. Guinea pigs were also injected intraperitoneally with tubercle bacilli and the solution given intravenously. The animals subjected to this treatment lived longer than the controls or recovered completely. Injection of the solution in tuberculous patients is followed within a few days by an aggraxation of the lung symptoms, an increase in the amount of sputum, rise of temperature of about 1 degree, hemorrhages, increase in the number of bacilli in the sputum. These symptoms subside gradually after a week or ten days, followed by improvement. From five to twenty injections are usually necessary to produce cessation of symptoms and disappearance of bacilli from the sputum. The number of injections in the individual case depends upon the stage and severity of the disease. Of 51 patients treated, marked improvement was obtained in 5; moderate in 19; slight in 9. Some favorable results were also obtained in other forms of tuberculosis. The effect on leprosy was extremely beneficial. It is probable that a cure might be effected if the treatment were continued for from six months to a year.—*The Chemotherapy of Leprosy and Tuberculosis., T. Sugai, Am. J. M. Sc., July, 1918, clvi, No. 1, 30.*

Amputation of Tuberculous Epiglottis.—The author draws upon the results of his own cases and the work of others respecting the amputation of the epiglottis in tuberculosis and concludes that the operation is quite as safe as tonsillectomy, even in severely exhausted patients. In nine out of every ten cases the operation is performed solely as a palliative measure, mainly for the relief of pain. But even when a cure of the tuberculosis is possible it is not essential that all of the diseased tissue be removed, since following amputation the remaining lesions usually undergo rapid healing. Healing of the operation stump is usually very rapid and the operation causes very little discomfort. The relief of pain is usually immediate and very striking, and there is often a very marked subsequent improvement in the patient's general condition due both to this absence of pain and the resulting capacity to take more nourishment and to get more rest. The effect upon the pulmonary disease, though only secondary, is often marvelous. There is one, and only one, contraindication to the operation, namely when the tuberculous process is beginning to involve the base of the tongue or the pharyngoepiglottic fold. Here the process progresses so rapidly that the operation offers no prospect of arrest or relief of symptoms. The one great indication for the operation is pain.—*Final Conclusions Regarding Amputation of the Epiglottis for Tuberculosis, L. B. Lockard, Col. Med., April 1918, xv, No. 4, 88.*

Plan for Fighting Tuberculosis in New York State.—The *Bulletin* of the New York State Department of Health for January shows that progress is being made in complying with the laws of 1917 which made mandatory the erection of a tuberculosis hospital in every county having a population of over 35,000. This law has affected twenty counties in all, of which the department has inspected sites, with the exception of Sullivan and Washington, which counties have appointed site committees. Sites have been approved in eleven counties and are being prepared for consideration in six others. The Tuberculosis Committee appointed by the Health Commissioner in July, 1917, has adopted a state-wide program for the following year, the main features of which are: The establishment of adequate tuberculosis hospital provision for each county in the State on the approximate basis of one bed for each average annual death in such county; the inspection of local tuberculosis hospitals during the year 1918, and the promotion of the adoption by them of the recommendations made subsequent to this department's survey in 1914–1915; the formulation of plans for the development of the county tuberculosis hospitals as the campaign center in each county; coöperation with the superintendent of Ray Brook in the establishment of a course of instruction for hospital superintendents; systematic efforts to secure the attendance of all local tuberculosis hospital superintendents at the Ray Brook courses of instruction; promotion of a systematic plan for the protection of children from tuberculosis infection, and, as an alternative to dispensaries, the establishment of out-patients' service and physicians' clinics to be conducted by the county hospital and superintendents in coöperation with health officers. The program also includes a widened range of activities for nurses and health officers in anti-tuberculosis work.

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* "The Choice of Tuberculins," by Benjamin White, Otisville, N. Y., Department of Health, City of New York. Read at the annual meeting of the Medical Society of the State of New York, at Saratoga Springs, May 18, 1916.

† Human or bovine type.

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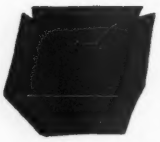

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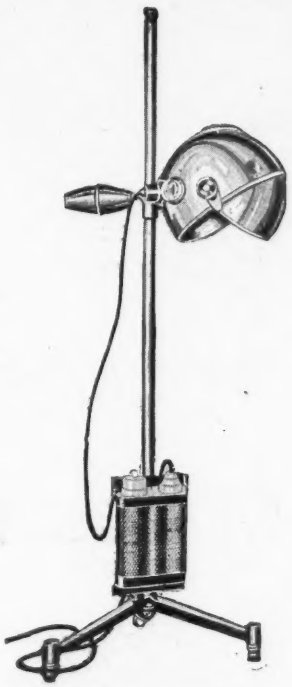

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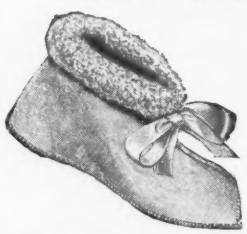

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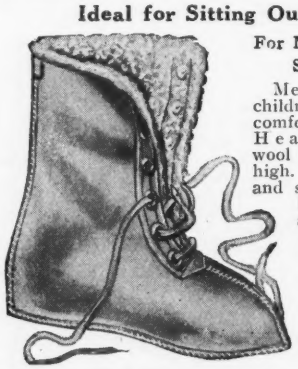

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